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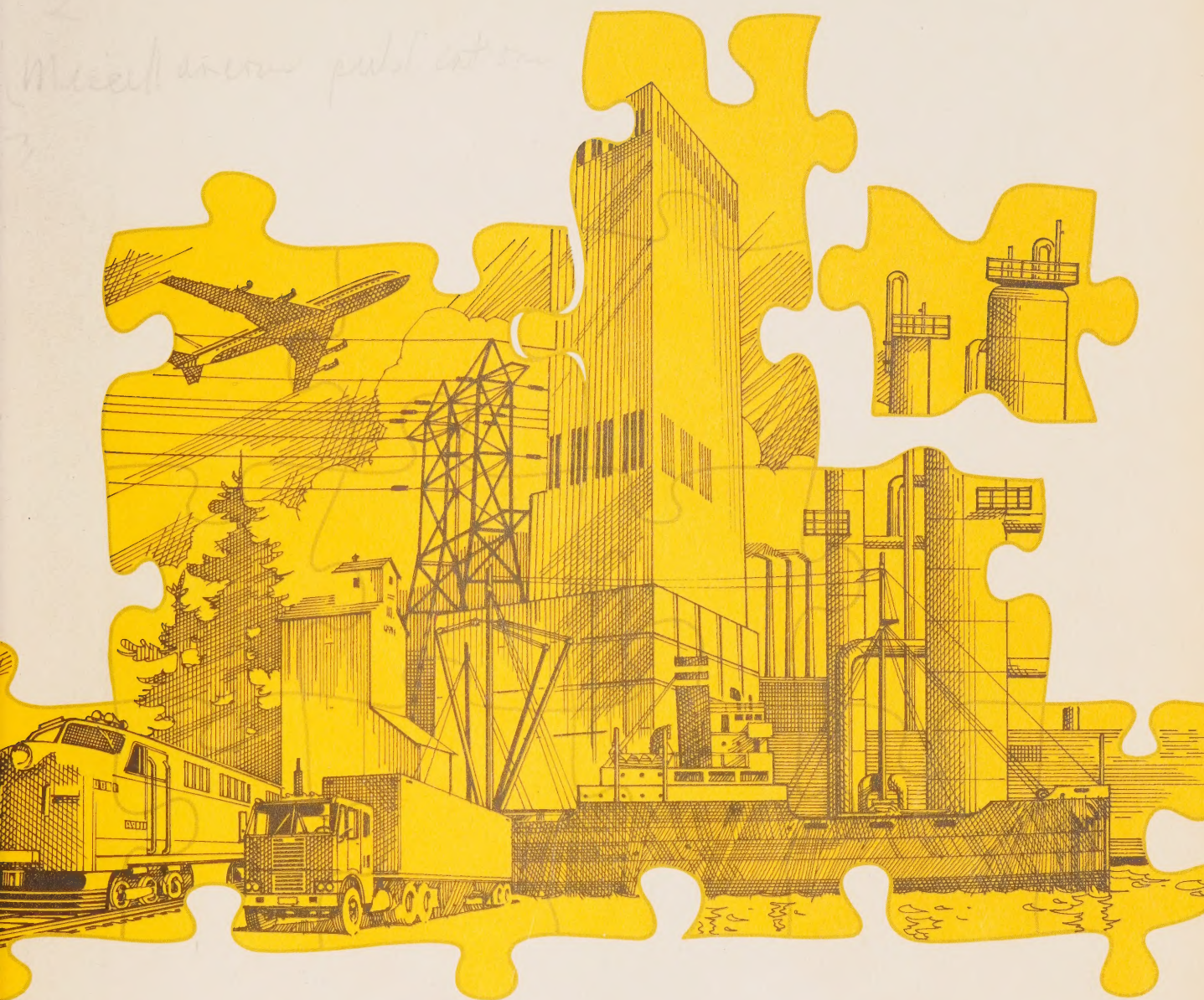




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# Royal Commission on Corporate Concentration



**STUDY NO. 20**

**Notes on the Economies  
of Large Firm Size**



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# Royal Commission on Corporate Concentration

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## Study No. 20

### Notes on the Economies of Large Firm Size

by

D.G. McFetridge

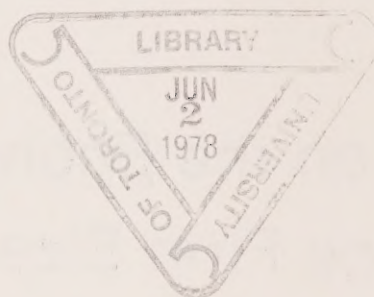
Carleton University

and

L.J. Weatherley

Department of Industry,  
Trade and Commerce

March 1977



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## FOREWORD

In April 1975, the Royal Commission on Corporate Concentration was appointed to "inquire into, report upon, and make recommendations concerning:

- (a) the nature and role of major concentrations of corporate power in Canada;
- (b) the economic and social implications for the public interest of such concentrations; and
- (c) whether safeguards exist or may be required to protect the public interest in the presence of such concentrations".

To gather informed opinion, the Commission invited briefs from interested persons and organizations and held hearings across Canada beginning in November 1975. In addition, the Commission organized a number of research projects relevant to its inquiry.

This study on the economies of large firm size was prepared by Donald McFetridge of Carleton University, and Larry Weatherley of the Department of Industry, Trade and Commerce. The study was one of the first commissioned by us. It discusses many of the central issues covered in our hearings and in related research, and discussed at length in our final Report. These include various dimensions of the problem of size and diversity; and economies of scale in marketing, finance, risk taking, progressiveness, management functions, and multi-plant operations. The commissioning of this study represented our attempt to gain insights on these subjects based on analysis by a professional economist, of the best data available in Canada.

Professor McFetridge is the author of a number of articles on Canadian industrial structure and performance, and has acted as consulting economist for the Treasury Board, the Department of Industry, Trade and Commerce, and the Ontario Economic Council. He is Associate Professor of Economics at Carleton University in Ottawa, and holds a Ph.D from the University of Toronto. His colleague in this research, Larry J. Weatherley was with the Department of Industry, Trade and Commerce, Government of Canada during the period he worked on this study.

The Commission is publishing this and other background studies in the public interest. We emphasize, however, that the analyses presented and conclusions reached are those of the author, and do not necessarily reflect the views of the Commission or its staff.

Donald N. Thompson  
Director of Research

## ACKNOWLEDGEMENTS

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Finally, the authors wish to thank the taxpayers of Canada for financing the study and to take responsibility and apologize for its shortcomings.

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## CHAPTER 1

### CORPORATE SIZE: A PERSPECTIVE ON THE PROBLEM

#### 1.1 INTRODUCTION

In any discussion of the pros and cons of the large corporation the battle lines are clearly drawn. According to one school of thought the large corporation is principally, if not solely, responsible for the high standard of living enjoyed by the inhabitants of western countries. The opposite school considers the large corporation to blame for most of the economic, social and political problems which continue to plague these countries.

It is the purpose of this study to recast this debate in analytical rather than emotive terms. The development of a framework within which the issues in the corporate power debate can be reduced to their essential elements and placed in perspective is the principal purpose of this chapter. Subsequent chapters are concerned with the examination of some of the issues themselves.

## 1.2 AN ANALYTICAL FRAMEWORK

By growing larger a firm may be able to produce a given output of goods or services with fewer resources. This frees resources to fill other needs and therefore increases the wealth of the community as a whole. When an increase in size results in a resource saving such as this, a real or social economy of scale is said to have occurred: by increasing the size of their firm the owners have increased both their own wealth and the wealth of the community as a whole.

By growing larger the firm may also be able to extract higher prices from its customers (monopoly power) and lower prices from its suppliers (monopsony power). In this case the wealth of owners and/or managers increases but does so at the expense of these customers and suppliers, so that their gains are cancelled out; the growth of the firm, while in the interest of its owners and managers, is no longer in the interest of the community as a whole. When an increase in firm size increases the wealth of its owners and managers but results in no net increase in the wealth of the community, a pecuniary economy of scale is said to have occurred.

It is perhaps the central tenet of price theory that, in the process of extracting additional wealth from its customers in return for its services, a firm actually reduces

the total wealth of the community. In its attempt to extract additional wealth it raises price relative to cost. As a result, the last or marginal unit consumed will have a value to its buyer which exceeds its cost, in terms of alternative goods and services lost to the community. That this price increase also has the effect of reducing the wealth of the community as a whole can be illustrated by examining the consequences of having the firm reduce price by just enough to add one unit to the quantity demanded. This additional unit will have a value to its buyer which exceeds the value of the goods and services which must be given up if it is to be produced. The total value of the goods and services produced and thus the wealth of the community has increased. Repetition of this experiment will yield additional wealth increases as long as the price involved exceeds cost, that is as long as the price involved exceeds the value of the goods and services which must be foregone in order to produce the marginal unit.

In summary, any change in the size of a firm must be assumed to increase the wealth of either its owners or managers. This wealth increase may take the form of a contribution to the productive capacity of the community, or, it may take the form of a transfer from other members of the community by which the firm may actually reduce the productive capacity of the community. In this latter case the growth of the firm is obviously in the interest of its owners and managers but not in the interest of the community as a whole.

It is because the decisions made by owners and managers regarding the size of a given firm will not necessarily increase the wealth of the community that there is some scope for government scrutiny of these decisions. In the United States this has taken the form of an antitrust policy which has had the effect of prohibiting mergers between competing firms (horizontal mergers) of significant size. This prohibition has been imposed without regard to any real economies which might result from such mergers. Under this approach the reduction of the number of competitors (and perhaps, though not necessarily, of the amount of competition) is viewed as undesirable in itself. Consideration of any effects on the net wealth of the community is ignored.

An alternative approach, formalized by Williamson (1965) is to assess the net effect of any external growth (growth by acquisition) on the wealth of the community. If external growth results in a net increase in the wealth of the community, it is allowed. If not, it is prohibited. Under this approach the size of firms and the number of competitors are means rather than ends. It amounts to an application of benefit:cost analysis to the external growth of each firm in the economy. Against the real economies of scale which result from an acquisition is set the wealth reduction which results from the efforts of the new, larger firm to increase the prices of the goods and services in which it trades relative to their costs. The amount of wealth which is simply transferred in

the process is usually ignored. If the net effect of the acquisition is to increase the productive capacity of the economy, it is allowed.

This approach has the merit of allowing the community to make a specific trade-off between the socially undesirable consequences of concentrated ownership or decision-making, whatever they may be, and any increases in productivity which result from large-scale operation. One possible decision rule might be to accept any consequences of concentrated ownership and decision-making provided the agglomeration of activities involved has the net effect of increasing the wealth of the community.

A third approach is simply to assume that any growth sought by the owners and managers of a firm is also in the interest of the community: that is, that growth always contributes to the wealth of the community. A number of circumstances combine to confer a certain legitimacy on this type of policy. In an open economy, the opportunity for the new larger firm to raise price relative to cost and effect the type of transfer which was shown to reduce the wealth of the community is often limited by the discipline of the international price. In an open economy such as Canada's characterized by relatively small (by international standards) firms, then, the presumption is that any growth results in a net increase in wealth.

Many would argue that this presumption should carry over into a closed economy. The basis of their argument is that, if prices exceed costs elsewhere in the economy, it can no longer be shown that a price increase resulting from a given acquisition decreases the wealth of the community. Recalling the demonstration of this point, after an acquisition, price is raised relative to cost so that the value, to its buyer, of the marginal unit consumed exceeds its cost. However, cost of the marginal unit can no longer be expressed as the value of goods and services which must be foregone to produce it. If prices exceed costs elsewhere in the economy the value of the goods and services foregone will exceed the payment to the resources necessary to produce the marginal unit and may exceed the value of that unit to its buyer. It can no longer be shown unequivocally that the efforts of the new larger firm to extract additional wealth from its customers reduces the total value of goods and services produced and thus the wealth of the community as a whole. The wealth increase to the community from real scale economies is unambiguous: the wealth decrease from increases in prices relative to costs is not. The latter should, some say, be therefore ignored.

To summarize, the community can take three possible attitudes to increases in firm size. The first is that if these increases are achieved by decreasing the number of competitors, broadly defined, they are to be forbidden regardless of the effect this may have on the productive capacity of the

community. The implementation of this approach would require little supporting research. It is merely a matter of defining competitors and counting them.

The second approach requires that the net wealth effects of an acquisition be assessed and be used to indicate what the community's aversion to any given change in the concentration of ownership and decision-making power will cost its members. This approach requires a significant amount of research. The conditions under which real economies of scale and/or increases in price relative to cost will occur must be ascertained either in general or on a case-by-case basis. Some commentators (Skeoch and MacDonald (1976)) have proposed that "significant" mergers be scrutinized on a case by case basis. Others such as Turner (1965) have argued that the probability of realizing real economies be established in general for each type of acquisition.

That horizontal mergers will, on balance, result in wealth gains to Canadians has been argued convincingly by a number of authors following in the steps of Williamson (1965) Investigation of the economies which might arise from vertical and conglomerate integration is just beginning. If such investigation were to reveal no evidence of real economies from vertical and conglomerate integration, nor any reason to expect them, their prohibition would cost Canadians nothing. There is a clear need to find what it would cost to indulge one's suspicions of centralized ownership and decision-making power

and prohibit conglomerate (multi-market) mergers or large size per se.

The third view of increases in firm size carried with it the assumption that what is good for the owners and managers involved in an acquisition is also good for the community as a whole. It is essentially a policy of nonintervention and, as such, requires little research to implement. It would, nevertheless, be of some interest to know if the foundation of this approach, namely the presumption that the real economies resulting from an acquisition will always predominate, is valid.

The research reported in this study follows the approach suggested by the second and, to a lesser extent, the third view of changes in firm size. It constitutes an attempt to assess the magnitude of the real economies of large size per se. If successful, this research will support some generalizations regarding the wealth effects of mergers of firms in different geographic or product markets. In short, it addresses the argument that large firm size arising from operation in many markets has made the Canadian economy more productive.

It is hoped that the generalizations arising from this research will provide some indication of the cost to Canadians of prohibiting acquisitions or growth of any kind by large firms. It may be that the conglomerate acquisition yields no real economies; in this case a predisposition against concentrated ownership and decision-making costs Canadians nothing. It may also be that the conglomerate acquisition yields signi-

ficant real economies; in this case Canadians will have to decide the size of the wealth loss they are willing to bear in order to preserve a pluralistic, decentralized society.

If the net wealth effect of conglomerate growth is to be established, both the real economies and the propensity to raise price relative to cost which result from conglomerate growth must be investigated. In this study only the former is investigated. The prevalence and wealth effects of the latter, often called the "abuses of conglomerate power" is left for others to investigate. For the sake of completeness, however, a short description of the methods by which large size per se is alleged to result in increases in price relative to cost and thus wealth losses appears in the next section of this chapter.

### 1.3 LARGE SIZE AND THE OPPORTUNITY TO ENGAGE IN RESTRICTIVE PRACTICES

It has been argued that the exploitation of monopoly power, that is the raising of prices relative to costs, has the effect of reducing the wealth of the community as a whole. There are a number of trade practices which, while arising from a desire to exploit monopoly power in one market, are allegedly much easier to effect if the firm involved is a large or multi-market firm. These practices have been listed by Edwards (1955), The Federal Trade Commission (1969) and Blair (1972) among others and include:

- (a) Reciprocal dealing which is defined by Stocking and Mueller (1957, p.905) in its elemental form as "... the use by a firm of its buying power to promote its sales.";
- (b) Cross-subsidization with predatory or disciplinary intent which is described by Turner (1965, pp.1339-40) as a practice whereby "... the large firm, cushioned by substantial profits from its other lines, will be strongly if not irresistably tempted to absorb the temporary losses of predatory pricing in order to reap the supposedly greater rewards of monopoly profits when its hapless rivals have been driven out of all or a good share of the market.";
- (c) Mutual forbearance which is defined by Blair (1972, p.49) as a behavioral response to a situation in which "... two

or more conglomerates confront one another as competitors in a number of different industries. Owing to differences in cost, market shares and product acceptance, it is only to be expected that the importance of these industries as sources of profits will vary considerably among the different conglomerates. A conglomerate that launches a competitive attack in an industry which is an important source of profits to a rival conglomerate can logically expect a retaliatory attack in an industry which is an important source of profits to it. Realizing this, it will abstain from initiating a competitive move in the first industry. And the greater the number of industries in which given conglomerates confront each other, the stronger the reason for mutual forbearance in each of them".

To the extent that these practices enable a firm either to increase its monopoly power, or to exploit more effectively a given level of monopoly power, and are facilitated by large size per se, they constitute a motive for attaining large size. Since additional profits obtained by these means are merely a transfer from customers and suppliers, and the act of effecting this transfer can itself reduce the wealth of the community, there are grounds for prohibiting acquisitions which have as their sole motive the facilitation of these practices.

This position has generated a great deal of comment (on reciprocity for example, see, Hinnegan (1966) and Lorrie

and Halpern (1970) and on cross-subsidization see Turner (1965)). The clear implication of these and other studies is that large (absolute) size and/or multi-market diversification are neither necessary nor sufficient to sustain the practice of either reciprocal dealing or cross-subsidization. If these practices do indeed reduce the wealth of the community as a whole, one should attack the unexploited market power which motivated them rather than size, diversification or the practice itself.

The limited relevance of the conglomerate, as conventionally defined, to the debate about these practices is illustrated in Regina v. Carnation Milk (1966) which is a classic example of disciplinary cross-subsidization. The defendant, although operating in a number of geographic markets, was neither particularly large in absolute terms nor extensively diversified across product markets. The extent of the divestiture necessary to eliminate Carnation's ability to repeat this practice is infinitely in excess of anything proposed by the most ardent foe of conglomerate size.

With regard to mutual forbearance, the most widely documented Canadian case is Regina v. Electric Reduction Company of Canada Ltd. (1970) in which the defendant was party, along with other chemical companies, to an agreement either to refrain from selling or to limit sales in each other's geographic or product markets. Again, the defendant was neither large in absolute terms nor diversified. This was an agreement not to diversify rather than a limitation of competition

resulting from diversification. Mutual forbearance is thus a broad term covering any agreement not to compete. It has as its foundation a scarcity of existing and potential competitors. Diversification is, again, neither necessary nor sufficient to sustain it.

The foregoing should not be taken to imply that a systematic investigation of a large number of cases of the type undertaken by Hay and Kelley (1974) would not show that reciprocal dealing, cross-subsidization and mutual forbearance are more likely to occur when the firm involved is either large absolutely or diversified. It implies only that there is no a priori reason to believe that this will be the case. Until a proper empirical investigation is conducted it is theory together with isolated examples (casual empiricism) that must form the basis for policy.

#### 1.4 SOCIAL ADVANTAGES OF LARGE SIZE

A large organization confers a benefit on society if it allows a given output to be produced with fewer resources (less capital and labour) than would be required by a set of smaller organizations. This benefit is known as a real or social economy of scale.

There are a number of reasons why a given increase in output can be achieved with a less than proportionate increase in the quantity of resources employed. Pratten (1971, pp.11-12) lists:

1. The physical indivisibility of some inputs, notably research, product development and design, advertising and promotion, management and certain items of capital equipment, with respect to output;
2. The economies of increased dimensions of physical facilities (tanks, pressure vessels and buildings);
3. The economies of the specialization of personnel;
4. The economies of massed reserves (back-up facilities).

Scale economies arising from these sources are necessary but not, in the last three cases sufficient to ensure that the per unit costs of the large firm will be lower than those of the small firm. Stigler (1951) has argued that specialist firms will emerge to perform those activities in a given productive process which are characterized by increasing returns to scale. If the specialists perform these functions at a

rate which exhausts the economies of scale and sell their services to both large and small firms in the quantity each requires, the small firm does not operate at a per unit cost disadvantage. It is only when there are significant transaction costs associated with purchasing a specialist's services on the market than an advantage accrues to the large firm. The latter can, in this case, perform the specialist's services internally at a rate which exhausts the economies of scale, while the smaller firm has the choice of buying the service on the market and incurring significant transaction costs or performing the service internally and incurring the diseconomies of small scale production.

It will be a recurring theme of this study that it is either the physical indivisibility of some inputs with respect to the level of output, or increasing returns occurring for any other reason (2 - 4 for example) in conjunction with significant costs of effecting market exchanges of the productive services involved, that yields a per unit cost advantage to the large producer.

The most prominent and widely investigated of the advantages of size are known as economies of scale in production or economies of scale at the plant level. A definition of and a discussion of the sources of economies of scale in production can be found in Pratten (1971) or Silberston (1972). Empirical investigations of production scale economies in a

Canadian context have been conducted by Eastman and Stykolt (1967), Hodgins (1968), Gorecki (1976), and Dickson (1976), among others.

Although the state of professional knowledge of the extent, nature and source of production scale economies is far from adequate, it is, nevertheless, better than the information available on the so-called "firm level" economies of scale. It is the latter which can induce a firm to operate in a number of geographic and product markets and utilize a number of plants - in short, to become large and diversified. Since the basis of the defence of the large multi-market enterprise must be the existence of real firm level economies, the relative paucity of information is a serious impediment to the development of policy on the issues of large size and conglomeration. The present study is an attempt to add to the small stock of knowledge on the extent, nature and source of real firm-level economies of scale.

Previous investigators, among them Robinson (1958), Turner (1965), Eastman and Stykolt (1967), Steiner (1975) and Scherer et al (1975) have identified real firm-level scale economies which could be categorized as follows:

- i) economies of scale in selling and promotion;
- ii) economies of scale in the assembly and disposition of capital;
- iii) economies of scale in scientific research and development;
- iv) economies of scale in management;
- v) economies of scale in multi-plant specialization and investment staging.

While adhering in a general fashion to this taxonomy, each of these authors has emphasized different economies and categories of economies. In his early study, for example, Robinson discussed categories (i), (ii) and (iv). Robinson (pp.34-9) ascribes the last of these, economies of scale in management, to the indivisibility of some managerial services, sales or cash flow forecasting for example, with respect to the size or output of the firm and to the benefit of specialization.

In their study of the advantages of large size Eastman and Stykolt listed categories (i) - (iii).

In some industries the long-run average cost curve of firms declines as their output grows beyond that of a single plant of the most efficient size. This occurs because economies of firm scale are composed not only of the factors determining the behaviour of the cost of plants of different sizes, but also of factors that can be separated in their functioning from the operation of the plants. These include principally the economies of scale in research and development, the differentiation of a firm's product from that of others, partly through research and development but also by advertising and other selling devices, and the strategic advantages of large firms in marketing in oligopolistic product markets. A large firm may also have advantages in obtaining capital either because of real economies in borrowing or because of oligopsonistic power in financial markets. For these several reasons plants may reap economies external to themselves and the plant long-run average cost curve is lower for each plant output if that plant belongs to a large multi-plant firm than if it does not. (p.83)

Steiner cites (i), (ii) and (iv) as the sources of the economies of large size. With respect to (i) Steiner argues that investigators should ask

... (1) Are economies in advertising and promotion achievable? (2) If so, are they 'real' economies to society? (3) Are such economies in some sense 'unworthy' because they involve expenditures on persuasion rather than production? (p.66).

He concludes that query (3) is, in effect, unanswerable and relies on Turner for his answer to (1) and (2). In his earlier essay on the subject Turner concluded that promotional economies

... may occur (a) because vital advertising media grant substantial quantity discounts; (b) because a larger absolute expenditure of funds will buy relatively more efficient promotional techniques; or (c) because the acquiring firm has a strong trade mark, the pulling power of which is easily transferred to the product of the acquired firm. (p.1332).

To the extent that quantity discounts reflect cost savings to the advertising media, the large firm's advantage is a true economy of scale and is both a private and a social economy because it reduces the resources necessary to obtain a given promotional result. The same must be said when a large expenditure will buy relatively more efficient advertising than a small one, as when a thousand-dollar full-page ad in the evening paper will bring in twenty times the added business that would be produced by a hundred-dollar distribution of handbills.

Similarly, advertising economies based on the transfer to the new product of an already established trade mark also reflect a true economy of scale. There is a more efficient exploitation of a particular asset here just as in the case when a firm economizes in the production of a particular commodity by manufacturing it with facilities that had not been fully utilized in the production of related items. (p.1337).

With respect to (ii) Steiner observes

Three kinds of advantages to the large corporations with regard to flows-of-funds are frequently adduced: genuine economies of larger scale use of funds, economies due to avoiding capital market imperfections and [pecuniary] economies due to avoiding tax barriers to the mobility of capital. (p.64).

He suggests that the "genuine economies of larger scale use of funds" arise from economies of scale in securities flotation and the lower probability of default by larger firms. He attaches the greatest weight, however, to the role of the large, diversified firm as a vehicle for transferring resources from sector to sector in response to differential rates of return.

If capital economies play a decisive role it is in the increased ability to channel internally generated and undistributed profits into more profitable endeavors. Here is an important complementarity with the economies attainable via efficient management. Capital budgeting is characteristically a major managerial responsibility; if it is also an art or a science in which it is possible to perform exceptionally well, access to a large cash flow and a wide variety of investment opportunities can make exceptionally profitable management possible. The conglomerate acquisition can increase both cash flows and investment opportunities. (p.65).

In his discussion of (iv), economies of scale in management, Steiner repeats Robinson's arguments regarding the physical indivisibility of some management services and the gains from employing specialists in others. He is properly wary of the argument that big firms can provide sufficient work for, and thus gain the benefit of, specialists in various managerial functions. To the extent that these

specialized skills can be purchased on the market in the quantities required by the smaller firm, the latter suffers no disadvantage. It is only in cases where the service is not divisible, or the cost of purchasing it is significant, that the small firm suffers a disadvantage. Steiner is correctly concerned, then, with the factors which would limit the extent of the market for specialized managerial services. Of these (pp.63-4) the most important factor is that the income of those providing managerial services from within the firm generally depends on the fortunes of the firm itself, and therefore they will be more concerned with implementation of their solutions than will outsiders. The necessity of integrating the enforcement and problem-solving functions of management may render the performance of various managerial services inseparable from the process of management itself. In this case the large firm will be more likely to benefit from the division of labour and specialization in its management.

In their detailed exposition of the sources of real economies of scale at the firm level, Scherer et al deal with each of (i) - (v). With respect to (i) economies of scale in selling and promotion, they reason that

There are several linkages through which firms may be drawn toward multi-plant operation because of advantages in large-scale sales promotion and product differentiation. First, through advertising, word of mouth, population diffusion, and other mechanisms which may or may not be under the firm's direct control, it is

often possible to gain a nationwide "image" or reputation which creates or reinforces consumer preferences for one's products. A favorable nationwide image can be an important asset whose full value is realized only by serving the entire national market .... Second, there may be economies of scale in utilizing the principal media of image creation and product differentiation - most prominently, advertising - which persist into the range of multi-plant production. Third, offering a broad line of products may provide certain advantages in fielding a sales force and securing market outlets .... Fourth, when product differentiation requires periodic design changes, the multi-plant producer might achieve savings spreading the costs of design, tooling, testing and retooling over a larger volume than the company with only a single efficient sized plant. (pp.239-49).

With respect to (ii) economies of scale in the assembly and disposition of capital, Scherer et al note that

It is well established from others' research that sizeable corporations can obtain new capital on more favorable terms and in bigger chunks than relatively small enterprises. Two main factors, risk and transactions costs are responsible. Primarily because of the risk-pooling opportunities ... large multi-plant companies experience less variability of sales and earnings over time than small, single-plant firms, *ceteris paribus*, and the actuarial risk of default tends to be lower .... Because there are market absorption and managerial constraints on rapid growth, a new capital issue of a given (but substantial) size is also considered less risky for a large enterprise than for a small one, all else equal. Consequently, smaller companies must generally raise their capital in smaller increments. And since many of the legal, negotiation, promotional, and servicing costs of floating a new securities issue or administering a loan are more or less fixed, flotation and servicing charges per dollar raised tend to be higher, the smaller is the enterprise and hence the smaller is its capital issue. (p.284).

With respect to (iii) economies of scale in research and development, Scherer et al cite the familiar arguments that

Large firms are said to have an advantage in mustering financial support for costly, risky research and development (R&D) projects; they may realize scale economies due to indivisibilities in research skills and equipment; and they may be able to spread the costs of a given research project over a larger existing or anticipated sales volume. (p.326).

In their discussion of category (iv), economies of scale in management, these authors present what is, in the light of the foregoing, a familiar set of conjectures.

It is conceivable that multi-plant firms realize scale economies in central administration and staff functions. Four hypotheses are relevant. First, certain administrative and service activities may require a staff of roughly fixed, and indivisible size over a broad range of production levels. If so, the unit cost of such functions will decline as they complement a larger volume of corporate output. Second, there are economies of massed reserves if the need for staff services fluctuates randomly over time. The multi-plant firm can average out such fluctuations more fully, securing better staff utilization and carrying smaller reserves against its relatively flat demand peaks. Third, large companies can sustain a richer division of labor, employing specialists in such fields as linear programming, arbitration law, quantitative market research, and the like where smaller firms must do without or make do with less intensively trained personnel. Fourth, the greater volume of business over which the talents of a top manager or central staff specialist will be applied in a large multi-plant corporation may warrant paying a higher salary to attract superior talent. (pp.321-2).

The first, third and fourth arguments are those of physical indivisibility and specialization. These have been evaluated above. The second argument, that of the "economies of massed reserves" requires further consideration.

Scherer et al list the following sources of economies of massed reserves: (a) the multi-plant firm will be able to respond to random production or regional demand functions by shifting output to plants with excess capacity; (b) the multi-plant firm will be able to respond to catastrophic shutdowns at one plant by shifting output to others; (c) the multi-plant firm can utilize more fully a central repair and maintenance staff; (d) the multi-plant firm can allocate output among plants so as to minimize production cost.

These economies are real only in a "second best" world where the industry concerned is a differentiated oligopoly in which the absence of a firm's product from the market reduces the range of choice available to the consumer and one firm can not meet its commitments by buying output from others. In a competitive environment multi-plant operation does not increase the wealth of society. Consider a corresponding set of single plant firms. Random production fluctuations, regional demand shifts and catastrophic shutdowns would result in the transfer of output to other firms rather than other plants of the same firm. Insofar as the consumer is concerned the result is the same. The risk borne by the owners of these single plant firms can be reduced to that borne by the owners of a multi-plant firm if their holdings are spread across all these firms.

It might be argued that the fear of "losing customers" will result in the maintenance of larger inventories

by the single-plant firm than by the multi-plant firm which is less likely to be "caught short". Again in a competitive environment this firm could purchase the output of others to meet its commitments. If it could not, the disappearance of its product for a time entails no loss. The inference that the multi-plant economies of massed reserves are in the least real depends on the existence of a differentiated oligopoly.

Insofar as a central repair staff is concerned, the arguments advanced at the outset apply. If it is physically indivisible with respect to output or if it is divisible but subject to significant transactions costs if traded, it will be a source of real scale economies.

Finally, the alleged superiority of a multi-plant firm over a set of single-plant firms in distributing output efficiently is surely not applicable in a competitive environment. In the latter one expects a tendency for output to be distributed in such a way that marginal costs equalize across firms. A multi-plant firm may be superior to a cartel which allocates output among members in a manner other than that which minimizes total cost. Again, this is a second-best argument.

Category (v), the economies of multi-plant investment staging and specialization, is peculiar to the Scherer et al study. In their exploration of the former concept these authors draw on the work of Manne (1967) who found, in effect, that under conditions of oligopoly, geographic decentralization and the necessity of making discrete capacity increments, the multi-plant firm could achieve a given capacity expansion

at a lower cost than could an equivalent number of single-plant oligopolists.

The work of Robinson, Eastman and Stykolt, Turner, Steiner and Scherer et al has allowed a framework for this study, the purpose of which is to evaluate the resource savings which result from the existence of large (diversified, multi-plant, multi-product) firms. In the following sections of this chapter the dimensions of multi-market (geographic and product) operation by firms in Canada along with the characteristics of the largest firms themselves are assessed. Chapter 2 contains an evaluation of the extent of real economies of scale in marketing and promotion. The possibility of economies of scale in financial activities is investigated in Chapter 3. In Chapter 4 economies of scale in research and development are examined. The final chapter discusses briefly economies of scale in management and economies of multi-plant specialization and summarizes the results obtained in the study.

## 1.5 LARGE AND MULTI-MARKET FIRMS: THE DIMENSIONS OF THE PROBLEM

The purpose of this section is to provide some indication of the importance of large firms in the economy and of the prevalence of multi-market operations in general. A multi-market firm is defined here as one which may produce goods or services assigned to more than one three-digit SIC code (for a summary of SIC codes see Table I page 35) from one or more plants or produce a single good or service in a number of plants (establishments). In the first case the firm is producing in a number of product markets, while in the second it is participating in a number of geographic markets. Among the factors which will explain participation in more than one product or geographic market are the real "firm level" economies of promotion, finance, research and development, management and multi-plant specialization and investment staging alluded to in the previous section and investigated in subsequent chapters.

Sections 1.5.3 and 1.5.4 are concerned with providing information on firms producing in more than one product market and in more than one geographic market respectively. Section 1.5.5 reports some information on the importance of large firms as a group, that is, on aggregate concentration ratios.

### 1.5.1 Problems of Measurement

The size of a firm is commonly measured by the number of its employees, the value of its assets, the value of its sales or its value added. The value of sales is more generally available than the other measures and is employed here. It is not, however, without disadvantages. Two firms may have equal sales but be integrated backward to different degrees. The firm which is integrated backward to a greater degree will be larger in the sense of having a greater value added. Thus the use of sales as a measure of size makes the often unwarranted assumption that the firms involved are vertically integrated to a similar extent.

There is also some question as to which entity is "the firm". Sales will be reported for each corporate entity. Corporate entities are, however, often linked (into enterprises) by common ownership. If the enterprise definition is the relevant definition of "the firm", one must decide the proportion of common ownership necessary to include a corporate entity in an enterprise. Again for reasons of availability this study employs corporate entity data. Where enterprise data are used they will be noted explicitly.

In this study the extent of product market diversification is usually measured by the number of three digit SIC codes to which a firm's products can be assigned (see Caves (1976) for some more sophisticated measures of diversification). Since the three digit industries differ in the

number and range of products they encompass, this measure does not necessarily reflect either the number or diversity of the goods and services produced by a given firm and is defensible principally on grounds of availability.

There is a final, more fundamental measurement problem, raised by the inability of the theorist to define precisely what is meant by the terms "firm" and "firm size". Fundamentally, the firm is a set of institutional arrangements which facilitate exchange among resource owners. Its function, the facilitation of exchange, is no different than that of the market itself. It is the burden of a literature which begins with Coase (1937) and includes recent contributions by McManus (1975) and Williamson (1975) that whether a transaction occurs within a firm or in the market depends on the relative costs of transacting in these institutions.

Transactions taking place within a firm are said to be characterized by a general contractual arrangement, the terms of which are subsequently specified and carried out under central direction and monitoring. It is argued that these characteristics make the firm particularly well suited to facilitate complex exchanges, the full ramifications of which are not known in advance. The more exchanges which occur within a firm, the bigger is that firm.

This definition of a firm raises several issues which are both interesting and relevant to the present investigation. The first is that there are a number of transactions which

would normally be defined as market exchanges but which involve contractual arrangements, the characteristics of which do not differ markedly from those of transactions taking place within the firm. Parties to requirements contracts or franchise or agency relationships with a firm may find that their contractual obligations are similar to those of the employees (members) of that firm. Should the former choose to change their relationship to that of an employee, the firm will under the conventional definition, have become larger, but little else will have changed.

If, for example, an automobile manufacturer moves along the continuum of possible exchange relationships and replaces a franchised dealer with a hired manager, the automobile manufacturer has become bigger but there has been only a marginal change in the nature of the exchanges taking place. The size of any firm is thus a function of the point along the continuum of exchange relationships at which market transactions are defined to begin. This definition is clearly an arbitrary one. Should lessee dealers be included when the size of an oil company is calculated? To what extent do the contractual arrangements entered into by the lessee differ from those of an employee? Is there sufficient reason to label one exchange as a market exchange and the other as being within the firm?

The point along the continuum of possible exchange relationships which is chosen by the contracting parties and hence the size of any firm involved depends on the costs of

enforcing the terms of the transaction. These costs are, in turn, a function of the property rights assigned in particular and of the legal and regulatory environment in general. Examples are provided by Martin (1973) and by Scherer et al (1975) who note that much of the backward integration of U.S. oil companies can be traced to a desire to take advantage of the more favorable tax treatment accorded income earned from crude oil production.

The legal environment has an obvious, if indirect, influence on the size of firms. It should be equally obvious that if the public authorities were to place some limit on firm size, as conventionally defined, or on vertical integration, the parties involved could, at some cost to themselves, move along the continuum of exchange relationships, entering into one which differs only marginally from that which was forbidden but which does not make the firm involved "bigger".

In sum, firm size is an arbitrary concept. Measured size, whether in terms of employees, value added, sales or assets and whether of corporate entities or enterprises, may not even approximate the extent of the network of relationships involved in the provision of a given service or set of services. Control of firm size by the state may affect only marginally the nature of the transactions occurring in the economy. It would seem that it is the nature of the exchanges which occur, rather than some arbitrary measure of size, that the authorities might wish to regulate.

### 1.5.2 Sources of Data

The data required for the profile of corporate size and diversification presented in this section are drawn from public sources. The importance of large firms can be inferred from rankings of the largest firms published by the Financial Post and by Canadian Business. A less extensive ranking can also be inferred from Fortune magazine's list of the 500 largest industrial companies outside the United States. A file of the financial statements of the largest public companies in Canada is maintained by the Financial Research Institute in Montreal. Similar information can be obtained from the Financial Post Corporations Service. Finally all federally incorporated public companies and federally incorporated private companies with annual sales in excess of \$10 million must file financial statements with the Department of Consumer and Corporate Affairs. These statements are available for public inspection and are summarized in the Bureau of Corporate Affairs Bulletin.

The SIC codes to which a firm's products are assigned can be found in Dun and Bradstreet's Canadian Key Business Directory. The latter provides up to six four-digit U.S. SIC codes for each firm listed. The Financial Post's Survey of Industrials also lists the products (not by SIC code) of the firms it surveys.

Linkages between corporate entities are detailed in Statistics Canada, Intercompany Ownership, 1972.

### 1.5.3 Product Market Diversification

Some information on the extent of product market diversification is provided by a sample of 312 Canadian public companies drawn from the Financial Research Institute tape. Table II classifies these firms as follows:

- (a) Not diversified: the products of the company are assigned, by Dun and Bradstreet, to the same four-digit U.S. SIC industry;
- (b) Diversified within a major group: the products of the company are assigned to more than one four-digit SIC industry but all industries to which products are assigned lie in the same major group (Canadian major groups are listed in Table I);
- (c) Diversified within a division: the products of the company are assigned to more than one major group but all the major groups involved are in the same division (see Table I);
- (d) Diversified outside a division: at least one of the four-digit industries to which the company's products are assigned is in different divisions from the others.

Companies producing products in different SIC divisions are further classified as to the interdivisional linkage involved. The classification is dichotomous. Interdivisional linkages are either "strictly vertical" (i.e. wholesaling and retailing or logging and saw mills) or "other" (i.e. construc-

tion and transportation services or mining and finance, insurance and real estate). This allows the separation of companies which produce unrelated or distantly related products from those which are merely involved in several stages of production of the same product.

The information required to undertake this classification was obtained from Dun and Bradstreet (1975) and by special correspondence with Statistics Canada. A frequency distribution of the number of companies falling within each of categories (a) ... (d) together with the fraction in category (d) which are in the "strictly vertical" and "other" sub-categories, is given in Table II.

Scrutiny of Table II indicates, first, that almost one-third of the companies examined lie in category (a). Their products can all be assigned the same SIC code. Second, one-third of the companies examined operated in more than one SIC division. That this is not indicative of conglomerate diversification is illustrated by the fact that half of these companies are characterized by an interdivisional relationship which is strictly vertical. Operations in one SIC division serve to provide inputs for operations in a second SIC division. This sub-category ((d)(i)) would be larger in size (by about five percentage points) if companies with activities which spanned two or more SIC divisions and which were mainly (but not strictly) vertically related were included.

The conclusion to be drawn here is that, of the companies examined here, perhaps two-fifths confined their acti-

vity to one SIC industry or, if they operate in more than one industry, the industries involved are vertically related. A relatively small fraction can be said to be conglomerates in the sense that they carry on a large number of distantly related activities. One should note, however, that the Dun and Bradstreet data do not provide an exhaustive list of the activities of any company. They list only the six most important lines of business. Moreover, most observers would expect conglomerate diversification to manifest itself through enterprise linkages rather than within a single corporate entity. These data do not indicate that conglomerate activity is unimportant: they do indicate that if the conglomerate phenomenon is to occur in Canada it must occur at the enterprise level.

To obtain a rough indication of the extent of enterprise level diversification a count was taken of the SIC codes assigned by Dun and Bradstreet to corporate entities linked to each of the ten largest industrial companies in Canada. Two corporate entities are considered linked if one holds, directly or indirectly, a 50% interest in the other. The results are tabulated in Table III. Rough as they are they indicate that the largest fraction of observed diversification occurs at the enterprise level. When linked corporate entities are included the number of SIC codes assigned by Dun and Bradstreet to each of the 10 largest firms increases, on average, by a factor of 4. There is some merit then in obtaining a distribution of enterprises

Table I  
Standard Industrial Classification  
1970

Division 1—Agriculture		Division 4—Mines (including Milling), Quarries and Oil Wells — Concluded	
Ind. No.		Ind. No.	
<b>Major Group 1—Experimental and Institutional Farms</b>		<b>Major Group 5—Services Incidental to Mining</b>	
001	Experimental and University Farms	096	Contract Drilling for Petroleum
003	Institutional Farms	098	Other Contract Drilling
		099	Miscellaneous Services Incidental to Mining
<b>Major Group 2—Farms (except Experimental and Institutional Farms)</b>		<b>Division 5—Manufacturing Industries</b>	
011	Livestock and Livestock Combination Farms	<b>Major Group 1—Food and Beverage Industries</b>	
013	Field Crop and Field Crop Combination Farms	101	Meat and Poultry Products Industries
015	Fruit and Vegetable Farms	102	Fish Products Industry
017	Other Crop and Livestock Combination Farms	103	Fruit and Vegetable Processing Industries
019	Miscellaneous Specialty Farms	104	Dairy Products Industry
<b>Major Group 3—Services Incidental to Agriculture</b>		105	Flour and Breakfast Cereal Products Industry
021	Services Incidental to Agriculture	106	Feed Industry
<b>Division 2—Forestry</b>		107	Bakery Products Industries
		108	Miscellaneous Food Industries
<b>Major Group 1—Logging</b>		109	Beverage Industries
031	Logging	<b>Major Group 2—Tobacco Products Industries</b>	
<b>Major Group 2—Forestry Services</b>		151	Leaf Tobacco Processors
039	Forestry Services	153	Tobacco Products Manufacturers
<b>Division 3—Fishing and Trapping</b>		<b>Major Group 3—Rubber and Plastics Products Industries</b>	
		162	Rubber Products Industries
<b>Major Group 1—Fishing</b>		165	Plastics Fabricating Industry, n.e.s.
041	Fishing	<b>Major Group 4—Leather Industries</b>	
<b>Major Group 2—Fishery Services</b>		172	Leather Tanneries
045	Fishery Services	174	Shoe Factories
<b>Major Group 3—Hunting and Trapping</b>		175	Leather Glove Factories
047	Hunting and Trapping	179	Luggage, Handbag and Small Leather Goods Manufacturers
<b>Division 4—Mines (including Milling), Quarries and Oil Wells</b>		<b>Major Group 5—Textile Industries</b>	
		181	Cotton Yarn and Cloth Mills
<b>Major Group 1—Metal Mines</b>		182	Wool Yarn and Cloth Mills
051	Placer Gold Mines	183	Man-made Fibre, Yarn and Cloth Mills
052	Gold Quartz Mines	184	Cordage and Twine Industry
057	Uranium Mines	185	Felt and Fibre Processing Mills
058	Iron Mines	186	Carpet, Mat and Rug Industry
059	Miscellaneous Metal Mines	187	Canvas Products, and Cotton and Jute Bags Industries
<b>Major Group 2—Mineral Fuels</b>		188	Automobile Fabric Accessories Industry
061	Coal Mines	189	Miscellaneous Textile Industries
064	Crude Petroleum and Natural Gas Industry	<b>Major Group 6—Knitting Mills</b>	
<b>Major Group 3—Non-Metal Mines (except Coal Mines)</b>		231	Hosiery Mills
071	Asbestos Mines	239	Knitting Mills (except Hosiery Mills)
072	Peat Extraction	<b>Major Group 7—Clothing Industries</b>	
073	Gypsum Mines	243	Men's Clothing Industries
079	Miscellaneous Non-Metal Mines	244	Women's Clothing Industries
<b>Major Group 4—Quarries and Sand Pits</b>		245	Children's Clothing Industry
083	Stone Quarries	246	Fur Goods Industry
087	Sand Pits or Quarries	248	Foundation Garment Industry
		249	Miscellaneous Clothing Industries
		<b>Major Group 8—Wood Industries</b>	
		251	Sawmills, Planing Mills and Shingle Mills
		252	Veneer and Plywood Mills
		254	Sash, Door and Other Millwork Plants
		256	Wooden Box Factories
		258	Coffin and Casket Industry
		259	Miscellaneous Wood Industries

**Division 5—Manufacturing Industries — Continued****Major Group 9—Furniture and Fixture Industries**

- 261 Household Furniture Manufacturers
- 264 Office Furniture Manufacturers
- 266 Miscellaneous Furniture and Fixtures Manufacturers
- 268 Electric Lamp and Shade Manufacturers

**Major Group 10—Paper and Allied Industries**

- 271 Pulp and Paper Mills
- 272 Asphalt Roofing Manufacturers
- 273 Paper Box and Bag Manufacturers
- 274 Miscellaneous Paper Converters

**Major Group 11—Printing, Publishing and Allied Industries**

- 286 Commercial Printing
- 287 Platemaking, Typesetting and Trade Bindery Industry
- 288 Publishing Only
- 289 Publishing and Printing

**Major Group 12—Primary Metal Industries**

- 291 Iron and Steel Mills
- 292 Steel Pipe and Tube Mills
- 294 Iron Foundries
- 295 Smelting and Refining
- 296 Aluminum Rolling, Casting and Extruding
- 297 Copper and Copper Alloy Rolling, Casting and Extruding
- 298 Metal Rolling, Casting and Extruding, n.e.s.

**Major Group 13—Metal Fabricating Industries (except Machinery and Transportation Equipment Industries)**

- 301 Boiler and Plate Works
- 302 Fabricated Structural Metal Industry
- 303 Ornamental and Architectural Metal Industry
- 304 Metal Stamping, Pressing and Coating Industry
- 305 Wire and Wire Products Manufacturers
- 306 Hardware, Tool and Cutlery Manufacturers
- 307 Heating Equipment Manufacturers
- 308 Machine Shops
- 309 Miscellaneous Metal Fabricating Industries

**Major Group 14—Machinery Industries (except Electrical Machinery)**

- 311 Agricultural Implement Industry
- 315 Miscellaneous Machinery and Equipment Manufacturers
- 316 Commercial Refrigeration and Air Conditioning Equipment Manufacturers
- 318 Office and Store Machinery Manufacturers

**Major Group 15—Transportation Equipment Industries**

- 321 Aircraft and Aircraft Parts Manufacturers
- 323 Motor Vehicle Manufacturers
- 324 Truck Body and Trailer Manufacturers
- 325 Motor Vehicle Parts and Accessories Manufacturers
- 326 Railroad Rolling Stock Industry
- 327 Shipbuilding and Repair
- 328 Boatbuilding and Repair
- 329 Miscellaneous Vehicle Manufacturers

**Major Group 16—Electrical Products Industries**

- 331 Manufacturers of Small Electrical Appliances
- 332 Manufacturers of Major Appliances (Electric and Non-Electric)
- 333 Manufacturers of Lighting Fixtures
- 334 Manufacturers of Household Radio and Television Receivers
- 335 Communications Equipment Manufacturers
- 336 Manufacturers of Electrical Industrial Equipment
- 338 Manufacturers of Electric Wire and Cable
- 339 Manufacturers of Miscellaneous Electrical Products

**Division 5—Manufacturing Industries — Concluded****Major Group 17—Non-Metallic Mineral Products Industries**

- 351 Clay Products Manufacturers
- 352 Cement Manufacturers
- 353 Stone Products Manufacturers
- 354 Concrete Products Manufacturers
- 355 Ready-Mix Concrete Manufacturers
- 356 Glass and Glass Products Manufacturers
- 357 Abrasives Manufacturers
- 358 Lime Manufacturers
- 359 Miscellaneous Non-Metallic Mineral Products Industries

**Major Group 18—Petroleum and Coal Products Industries**

- 365 Petroleum Refineries
- 369 Miscellaneous Petroleum and Coal Products Industries

**Major Group 19—Chemical and Chemical Products Industries**

- 372 Manufacturers of Mixed Fertilizers
- 373 Manufacturers of Plastics and Synthetic Resins
- 374 Manufacturers of Pharmaceuticals and Medicines
- 375 Paint and Varnish Manufacturers
- 376 Manufacturers of Soap and Cleaning Compounds
- 377 Manufacturers of Toilet Preparations
- 378 Manufacturers of Industrial Chemicals
- 379 Miscellaneous Chemical Industries

**Major Group 20—Miscellaneous Manufacturing Industries**

- 391 Scientific and Professional Equipment Industries
- 392 Jewellery and Silverware Industry
- 393 Sporting Goods and Toy Industries
- 397 Signs and Displays Industry
- 399 Miscellaneous Manufacturing Industries, n.e.s.

**Division 6—Construction Industry****Major Group 1—General Contractors**

- 404 Building Construction
- 406 Highway, Bridge and Street Construction
- 409 Other Construction

**Major Group 2—Special-Trade Contractors**

- 421 Special-Trade Contractors

**Division 7—Transportation, Communication and Other Utilities****Major Group 1—Transportation**

- 501 Air Transport
- 502 Services Incidental to Air Transport
- 503 Railway Transport
- 504 Water Transport
- 505 Services Incidental to Water Transport
- 506 Moving and Storage, Used Goods, Uncrated
- 507 Other Truck Transport
- 508 Bus Transport, Interurban and Rural
- 509 Urban Transit Systems
- 512 Taxicab Operations
- 515 Pipeline Transport
- 516 Highway and Bridge Maintenance
- 517 Miscellaneous Services Incidental to Transport
- 519 Other Transportation

**Major Group 2—Storage**

- 524 Grain Elevators
- 527 Other Storage and Warehousing

**Division 7 – Transportation, Communication  
and Other Utilities – Concluded**

**Major Group 3 – Communication**

- 543 Radio and Television Broadcasting
- 544 Telephone Systems
- 545 Telegraph and Cable Systems
- 548 Post Office

**Major Group 4 – Electric Power, Gas and Water Utilities**

- 572 Electric Power
- 574 Gas Distribution
- 576 Water Systems
- 579 Other Utilities

**Division 8 – Trade**

**Major Group 1 – Wholesale Trade**

- 602 Wholesalers of Farm Products
- 606 Wholesalers of Coal and Coke
- 608 Wholesalers of Petroleum Products
- 611 Wholesalers of Paper and Paper Products
- 612 Wholesalers of General Merchandise
- 614 Wholesalers of Food
- 615 Wholesalers of Tobacco Products
- 616 Wholesalers of Drugs and Toilet Preparations
- 617 Wholesalers of Apparel and Dry Goods
- 618 Wholesalers of Household Furniture and Furnishings
- 619 Wholesalers of Motor Vehicles and Accessories
- 621 Wholesalers of Electrical Machinery, Equipment and Supplies
- 622 Wholesalers of Farm Machinery and Equipment
- 623 Wholesalers of Machinery and Equipment, n.e.s.
- 624 Wholesalers of Hardware, Plumbing and Heating Equipment
- 625 Wholesalers of Metal and Metal Products, n.e.s.
- 626 Wholesalers of Lumber and Building Materials
- 627 Wholesalers of Scrap and Waste Materials
- 629 Wholesalers, n.e.s.

**Major Group 2 – Retail Trade**

- 631 Food Stores
- 642 General Merchandise Stores
- 652 Tire, Battery and Accessories Stores
- 654 Gasoline Service Stations
- 656 Motor Vehicle Dealers
- 658 Motor Vehicle Repair Shops
- 663 Shoe Stores
- 665 Men's Clothing Stores
- 667 Women's Clothing Stores
- 669 Clothing and Dry Goods Stores, n.e.s.
- 673 Hardware Stores
- 676 Household Furniture and Appliance Stores
- 678 Radio, Television and Electrical Appliance Repair Shops
- 681 Drug Stores
- 691 Book and Stationery Stores
- 692 Florists' Shops
- 694 Jewellery Stores
- 695 Watch and Jewellery Repair Shops
- 696 Liquor, Wine and Beer Stores
- 697 Tobacconists
- 699 Retail Stores, n.e.s.

**Division 9 – Finance, Insurance and Real Estate**

**Major Group 1 – Finance Industries**

- 701 Banks and Other Deposit Accepting Establishments
- 703 Other Credit Agencies
- 705 Security Brokers and Dealers (including Exchanges)
- 707 Investment and Holding Companies
- 715 Canadian Offices of Canadian-Incorporated Companies Classified as Non-Canadian

**Division 9 – Finance, Insurance  
and Real Estate – Concluded**

**Major Group 2 – Insurance Carriers**

- 721 Insurance Carriers

**Major Group 3 – Insurance Agencies and Real Estate Industry**

- 735 Insurance and Real Estate Agencies
- 737 Real Estate Operators

**Division 10 – Community, Business and Personal Service  
Industries**

**Major Group 1 – Education and Related Services**

- 801 Kindergartens and Nursery Schools
- 802 Elementary and Secondary Schools
- 803 Schools of Art and of the Performing Arts
- 804 Vocational Centers, Trade Schools and Business Colleges
- 805 Post-Secondary Non-University Educational Institutions
- 806 Universities and Colleges
- 807 Libraries, Museums and Other Repositories
- 809 Education and Related Services, n.e.s.

**Major Group 2 – Health and Welfare Services**

- 821 Hospitals
- 822 Related Health Care Institutions
- 823 Offices of Physicians and Surgeons
- 824 Offices of Para-medical Personnel (Practitioners)
- 825 Offices of Dentists
- 826 Diagnostic and Therapeutic Services, n.e.s.
- 827 Miscellaneous Health Services
- 828 Welfare Organizations

**Major Group 3 – Religious Organizations**

- 831 Religious Organizations

**Major Group 4 – Amusement and Recreation Services**

- 841 Motion Picture Theatres
- 842 Motion Picture Production and Distribution
- 843 Bowling Alleys and Billiard Parlours
- 844 Golf Clubs and Country Clubs
- 845 Theatrical and Other Staged Entertainment Services
- 849 Miscellaneous Amusement and Recreation Services

**Major Group 5 – Services to Business Management**

- 851 Employment Agencies and Personnel Suppliers
- 853 Computer Services
- 855 Security and Investigation Services
- 861 Offices of Accountants
- 862 Advertising Services
- 863 Offices of Architects
- 864 Engineering and Scientific Services
- 866 Offices of Lawyers and Notaries
- 867 Offices of Management and Business Consultants
- 869 Miscellaneous Services to Business Management

**Major Group 6 – Personal Services**

- 871 Shoe Repair Shops
- 872 Barber and Beauty Shops
- 873 Private Households
- 874 Laundries, Cleaners and Pressers (except Self-Service)
- 876 Self-service Laundries and Dry Cleaners
- 877 Funeral Services
- 879 Miscellaneous Personal Services

**Major Group 7 – Accommodation and Food Services**

- 881 Hotels and Motels
- 883 Lodging Houses and Residential Clubs
- 884 Camping Grounds and Trailer Parks
- 886 Restaurants, Caterers and Taverns

**Division 10—Community, Business and Personal Service  
Industries — Concluded**

**Major Group 8—Miscellaneous Services**

891	Labour Organizations and Trade Associations
893	Photographic Services, n.e.s.
894	Automobile and Truck Rental
895	Machinery and Equipment Rental
896	Blacksmithing and Welding Shops
897	Miscellaneous Repair Shops
898	Services to Buildings and Dwellings
899	Miscellaneous Services, n.e.s.

**Division 11—Public Administration and Defence**

**Major Group 1—Federal Administration**

902	Defence Services
909	Other Federal Administration

**Division 11—Public Administration  
and Defence — Concluded**

**Major Group 2—Provincial Administration**

931	Provincial Administration
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**Major Group 3—Local Administration**

951	Local Administration
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**Major Group 4—Other Government Offices**

991	Other Government Offices
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**Division 12—Industry Unspecified or Undefined**

999	Canadian-Incorporated Companies Classified as Non- Canadian
000	Unspecified or Undefined

Table II

PRODUCT MARKET DIVERSIFICATION OF A  
SAMPLE OF CANADIAN PUBLIC COMPANIES - 1975

Category	Frequency	Relative Frequency	Cumulative Relative Frequency
(a) Not Diversified	95	30.4	30.4
(b) Diversified within a major group	54	17.3	47.8
(c) Diversified within a Division (but out- side a major group)	54	17.3	65.1
(d) Diversified across Divisions (total)	109	34.9	100.0
(d)(i) Strictly vertical interdivisional diversification	55	17.6	-
(d)(ii) Not strictly vertical interdivisional diversification	54	17.3	-
TOTAL ((a)+...+(d))	312	100.0	-

TABLE III

ENTERPRISE VS. CORPORATE  
ENTITY DIVERSIFICATION

1975 Sales Rank	Name of Corporate Entity	Number of Four- Digit Industries: Corporate Entity	Number of Four- Digit Industries: Enterprise
1.	Ford Motor Company of Canada	1	5
2.	General Motors of Canada Ltd.	4	8
3.	Imperial Oil Ltd.	3	16
4.	Canadian Pacific Ltd.	4	23
5.	Bell Canada	3	7
6.	Massey Ferguson Ltd.	1	6
7.	Chrysler Canada Ltd.	3	12
8.	Alcan Aluminium Ltd.	2	13
9.	Shell Canada Ltd.	3	8
10.	Gulf Oil Canada Ltd.	4	15

Source: The Financial Post 300 (Summer, 1976)  
Canadian Key Business Directory 1976  
Intercompany Ownership, 1972

by degree of diversification.

Some information of this sort has been provided by McVey (1972). The latter finds that multi-establishment enterprises accounted for 61.4% and 64.4% of manufacturing shipments in 1965 and 1968 respectively. McVey also calculates a Herfindahl index to indicate the extent to which these multi-establishment enterprises are diversified across three-digit industries. The Herfindahl index is calculated as

$$H = \sum_{i=1}^n x_i^2$$

where  $x_i$  is the fraction of the sales of the enterprise which are of products assigned to the  $i^{\text{th}}$  industry and  $n$  is the number of industries to which the products sold may be assigned. The greater the number of industries to which the products of a firm may be assigned and the more evenly sales are distributed across these industries, the lower is the  $H$  index. A distribution of  $H$  indexes is presented in Table IV. The modal value of the  $H$  index is .5. Among the types of diversification with which this value is consistent are: (a) sales of equal value in two SIC industries, (b) sales distributed across three industries in the fractions  $2/3$ ,  $1/6$ ,  $1/6$  and (c) sales distributed across four industries in the fractions  $43/64$ ,  $13/64$ ,  $4/64$ ,  $4/64$ . While the judgement is best made in relative terms, the diversification implied by Table IV seems neither extensive nor widespread.

TABLE IV

H INDEXES OF DIVERSIFICATION  
FOR MULTI-ESTABLISHMENT ENTERPRISES:  
CANADA 1968

H	% Enterprises	% Shipments
1.00*	48.2	16.0
.90 - .99	4.4	8.5
.80 - .89	6.3	6.8
.70 - .79	5.5	11.1
.60 - .69	9.0	13.7
.50 - .59	15.2	21.7
.40 - .49	4.6	8.5
.30 - .39	4.6	5.2
.20 - .29	1.9	6.2
.10 - .19	.3	2.4
0 - .09	0	0

\* denotes multi-establishment, single industry firms.

Source McVey (1972) p.155.

The Standard Industrial Classification provides a very crude framework within which to measure product market diversification. There are, for example, producers assigned to only one SIC industry which produce many brands (distillers, brewers, pharmaceuticals manufacturers, cosmetics manufacturers, grain millers, etc.) and thus appeal to many submarkets. These submarkets may be every bit as distinct as the markets defined in the Standard Industrial Classification. To provide some information on product diversification as seen by the producers themselves, the number of different brands advertised nationally by 114 companies on the Financial Research Institute tape is tabulated and its frequency distribution is presented in Table V.

Table V reveals that half of these companies advertise either no specific product or one specific product nationally and cannot, therefore, be viewed as diversified. It should be noted that approximately 25 per cent of these are primary resource and utility companies which will employ devices other than advertising to appeal to various sub-markets. One-third of the companies examined advertise five or more separate products nationally. Meat packers, distillers, grain millers, cigarette manufacturers, electrical appliance manufacturers and automobile manufacturers advertise the highest number of brands per firm. To the extent that each brand corresponds to an

TABLE V

NUMBER OF NATIONALLY ADVERTISED BRANDS  
PER COMPANY, CANADA, 1970

Number of Brands	Frequency (number of companies	Relative Frequency %	Cumulative Relative Frequency
O-corporate image only	23	20.2	20.2
1	20	17.5	37.7
2	17	14.9	52.6
3	9	7.9	60.5
4	6	5.3	65.8
5	6	5.3	71.1
6	6	5.3	76.4
7	4	3.5	79.9
8	4	3.5	83.4
9	3	2.6	86.0
10	3	2.6	88.6
11-15	4	3.5	92.1
16-20	2	1.8	93.9
21-25	4	3.5	97.4
26-30	2	1.8	99.2
> 30	<u>1</u>	<u>.8</u>	100.0
	114	100.0	

identifiable sub-market and these sub-markets are independent, these firms are more diversified than the range of SIC codes which they have been assigned would indicate.

#### 1.5.4 Geographic Market Diversification

Some indication of the extent of multi-plant operation and therefore, it is hoped the number of geographic markets in which manufacturing, mining and logging enterprises operate, is provided by the study "Industrial Organization and Concentration in the Manufacturing, Mining and Logging Industries" (Statistics Canada, 1975). From the data therein, the average number of establishments per enterprise, and the average number of establishments per enterprise of the largest four and largest eight enterprises, can be calculated for 114 of a total of 124 three-digit SIC industries. The distributions of these industries by number of establishments per enterprise, per enterprise among the largest four, and per enterprise among the largest eight are given in Tables VI, VII and VIII respectively.

A comparison of Tables VI and VII reveals a clear tendency toward multi-plant activity on the part of the largest enterprises and an equally clear tendency to single-plant operation on the part of the remaining enterprises in most industries. In almost 60% of the industries examined, the largest four enterprises operate an average of more than two establishments each. When all enterprises are

included in the calculation, the average number of establishments per enterprise is less than two (and is in fact close to one) in the overwhelming proportion of the industries examined.

The prevalence of multi-plant activity among the largest firms suggests that there are gains - real or pecuniary firm level economies - to be made from this type of operation and that these gains are broadly distributed across industries. The coexistence of a large number of single establishment enterprises however, suggests that these advantages are not overwhelming.

Some clues as to the nature of the firm (enterprise) level advantages may be found in the characteristics of the industries with the highest number of establishments per enterprise. These are:

- (i) Feed Manufacturers
- (ii) Dairy Factories
- (iii) Bakeries
- (iv) Paper Box and Bag Manufacturers
- (v) Scientific and Professional Equipment  
Manufacturers

They are, without exception, characterized by small establishments serving local markets. It is easy to imagine that whatever firm level economies exist might not be exhausted by the single-plant firm; it is less easy to infer what these advantages might be. Promotional, research and plant specialization advantages are likely to be trivial. Any management or financial advantages held by the multi-establishment enterprise are

not obvious.

While it does not resolve the issue, the industries with the fewest number of establishments per enterprise are:

- (i) Aircraft and parts
- (ii) Office and Store Machinery
- (iii) Heating Equipment
- (iv) Boiler and Plate Works
- (v) Electric Lamp and Shade Industry

Three of these industries are characterized by national markets. One must assume that this is also true of the other two.

It is instructive to compare the Canadian and American frequency distributions of the average number of establishments per enterprise. The latter, along with the average number of establishments per enterprise for the largest four and eight enterprises, can be calculated for 411 four-digit SIC industries from information found in the census of Manufacturers (Bureau of the Census, 1971). The distributions of these averages by industry are reported in Tables IX, X and XI.

Inspection of Tables VI ... XI reveals that while the distributions of the average number of establishments per enterprise are similar, the average number of establishments owned by the largest four and eight enterprises is distinctly higher in the United States. In almost 80% of U.S. four-digit industries the largest four enterprises operate an average of more than two establishments each. The failure of the U.S. distribution to fit the Canadian distribution is confirmed by a  $\chi^2$  test

for goodness of fit (Yamane, 1973, pp.765-73). Assuming, as seems reasonable, that U.S. establishments are, on average, at least as big as Canadian establishments, the implications of this finding are

- (a) That there are unexploited firm level scale economies in Canada, or
- (b) That Canadian firms exploit firm level economies by product rather than geographic market diversification, or
- (c) That the economies of operating in more than one geographic market are greater in the United States than in Canada.

There is some evidence in favour of (c). The economies of multi-plant specialization demonstrated so ably by Beckenstein (1975), and multi-plant investment staging examined by Manne (1967) depend on the proximity of the markets involved. That is, economies are obtained by supplying one market with products of a plant located in another. Given Canada's lower population density the notion of proximate market areas in which the multi-plant firm can engage in cross-hauling at a given point in time (product specialization) or over a period of time (investment staging) is difficult to sustain.

With respect to the characteristics of industries with a large number of establishments per enterprise, the U.S. results confirm the Canadian results. The industries with the largest number of establishments per enterprise are:

- (i) Industrial gases

Table VI

AVERAGE NUMBER OF ESTABLISHMENTS PER  
ENTERPRISE BY THREE-DIGIT INDUSTRY, 1970

Number of Establishments per Enterprise	Frequency (Number of Industries)	Relative Frequency	Cumulative Relative Frequency
1 - 2	106	93.0	93.0
2 - 3	5	4.4	97.4
3 - 4	2	1.8	99.1
4 - 5	1	.9	100.0
	<hr/> 114	<hr/> 100.0	

Table VII

AVERAGE NUMBER OF ESTABLISHMENTS  
OWNED BY THE LARGEST 4 ENTERPRISES, 1970

Number of Establishments per Enterprise	Frequency (Number of Industries)	Relative Frequency (%)	Cumulative Relative Frequency
1 - 2	47	41.2	41.2
2 - 3	21	18.4	59.6
3 - 4	17	14.9	74.6
4 - 5	9	7.9	82.5
5 - 6	2	1.8	84.2
6 - 7	4	3.5	87.7
7 - 8	2	1.8	89.5
8 - 9	3	2.6	92.1
9 -10	2	1.8	93.9
> 10	<u>7</u>	<u>6.1</u>	100.0
	114	100.0	

Table VIII

AVERAGE NUMBER OF ESTABLISHMENTS  
OWNED BY THE LARGEST 8 ENTERPRISES, 1970

Number of Establishments per Enterprise	Frequency (Number of Industries)	Relative Frequency (%)	Cumulative Relative Frequency
1 - 2	59	51.8	51.8
2 - 3	24	21.1	72.8
3 - 4	12	10.5	83.3
4 - 5	4	3.5	86.8
5 - 6	6	5.3	92.1
6 - 7	3	2.6	94.7
7 - 8	2	1.8	96.5
8 - 9	0	0	96.5
9 -10	0	0	96.5
> 10	<u>4</u>	<u>3.5</u>	100.0
	114	100.0	

Table IX

AVERAGE NUMBER OF ESTABLISHMENTS  
PER ENTERPRISE, UNITED STATES

Number of Establishments per Enterprise	Frequency (Number of Industries)	Relative Frequency (%)	Cumulative Relative Frequency
1 - 2	396	96.4	96.4
2 - 3	9	2.2	98.5
3 - 4	4	1.0	99.5
4 - 5	<u>2</u>	<u>.5</u>	100.0
	411	100.0	

Table x

AVERAGE NUMBER OF ESTABLISHMENTS  
OWNED BY THE LARGEST 4 ENTERPRISES  
UNITED STATES,

Number of Establishments per Enterprise	Frequency (Number of Industries)	Relative Frequency (%)	Cumulative Relative Frequency
1 - 2	88	21.4	21.4
2 - 3	78	19.0	40.4
3 - 4	48	11.7	52.1
4 - 5	47	11.4	63.5
5 - 6	35	8.5	72.0
6 - 7	18	4.4	76.4
7 - 8	17	4.1	80.5
8 - 9	11	2.7	83.2
9 -10	10	2.4	85.6
> 10	<u>59</u>	<u>14.4</u>	100.0
	411	100.0	

Table XI

AVERAGE NUMBER OF ESTABLISHMENTS  
OWNED BY THE LARGEST 8 ENTERPRISES  
UNITED STATES

Number of Establishments per Enterprise	Frequency (Number of Industries)	Relative Frequency (%)	Cumulative Relative Frequency
1 - 2	121	29.4	29.4
2 - 3	80	19.5	48.9
3 - 4	65	15.8	64.7
4 - 5	37	9.0	73.7
5 - 6	22	5.4	79.1
6 - 7	23	5.6	84.7
7 - 8	8	1.9	86.6
8 - 9	8	1.9	88.6
9 -10	7	1.7	90.3
> 10	<u>40</u>	<u>9.7</u>	100.0
	411	100.0	

- (ii) Bakeries
- (iii) Fluid Milk
- (iv) Manufactured ice
- (v) Metal cans

with the exception of (v) all are characterized by local markets and plants that may be too small to exhaust any economies of scale in form level functions. Again, one can not readily infer which functions these might be. This is a matter for further investigation.

#### 1.5.5 Aggregate Concentration

Concentration of economic decision-making in relatively few hands can only be defined as a problem in relative terms. That is, high levels of concentration are, by themselves, meaningless; they must be high relative to past levels of concentration, or high relative to that which prevails in other countries. Two questions must therefore be asked. First, is aggregate concentration increasing? Second, is aggregate concentration higher than that which obtains in other countries?

An answer of sorts to the first is provided in Table XII which shows that there was no appreciable change in the percentage of manufacturing shipments accounted for by the largest 20 enterprises over the period 1965-1970. Similarly Table XIII shows that, apart from an increase in the share of industrial (manufacturing, mining and utilities) assets owned by one firm, Canadian Pacific, there has been little

change in the fraction of industrial assets in the hands of the largest 20 corporations. The increased share of Canadian Pacific could itself be due to a consolidation of its accounts rather than a change in the fraction of industrial assets actually controlled by the company.

If aggregate concentration has not been increasing is it nevertheless, higher than in other countries? United States and Canadian aggregate concentration are compared in Table XIV. It is clear that, insofar as the manufacturing sector is concerned aggregate concentration is much higher in Canada. The 50 largest Canadian enterprises account for almost the same fraction of manufacturing value added as do the 100 largest U.S. enterprises.

Whether this constitutes a problem for Canadians is, of course, a major topic of concern for this study. What is undeniable is that, while it does not appear to be becoming more concentrated, economic decision-making power is, by the conventional measures, more concentrated in Canada than in the United States.

TABLE XII

## AGGREGATE CONCENTRATION

CANADA 1965-1970

% manufacturing shipments accounted for by the	1965	1968	1970
largest 4 enterprises	8.40	9.63	8.86
largest 8 enterprises	13.30	14.36	13.35
largest 12 enterprises	17.20	17.40	16.83
largest 16 enterprises	20.80	21.00	20.32
largest 20 enterprises	23.10	24.22	23.64

Source: Statistics Canada Cat. No. 31-402 (1975.  
McVey (1972) p.117.

TABLE XIII

## AGGREGATE CONCENTRATION, CANADA 1969 and 1976

Asset Rank	Firm - 1969*	% of total Industrial Assets	Firm - 1975	% of total Industrial Assets
1	Bell Canada	3.94	Bell Canada	4.36
2	Canadian Pacific Railway Ltd.	6.48	Canadian Pacific Ltd.	8.49
3	Alcan Aluminum Ltd.	8.97	Inco Ltd.	10.49
4	Inco Ltd.	10.80	Alcan Aluminum Ltd.	12.49
5	Imperial Oil Ltd.	12.49	Imperial Oil Ltd.	14.44
6	International Utilities Corp.	13.98	Brascan Ltd.	15.93
7	Distillers Corporation - Seagrams Ltd.	15.46	Seagram Ltd.	17.25
8	Massey Ferguson Ltd.	16.73	Massey Ferguson Ltd.	18.56
9	Gulf Oil Canada Ltd.	17.89	Noranda Mines Ltd.	19.87
10	Brascan Ltd.	19.03	Gulf Oil Canada Ltd.	21.01
11	Shell Canada Ltd.	19.99	Steel Co. of Canada Ltd.	22.12
12	MacMillan Bloedel Ltd.	20.95	Ford Motor Co. of Canada Ltd.	23.17
13	Ford Motor Co. of Canada Ltd.	21.91	Anglo-Canadian Telephone Co.	24.22
14	Noranda Mines Ltd.	22.86	Trans Canada Pipelines Ltd.	25.26
15	Steel Co. of Canada Ltd.	23.79	Shell Canada Ltd.	26.29
16	Trans Canada Pipelines Ltd.	24.67	Canada Development Corp.	27.14
17	Anglo Canadian Telephone Co.	25.51	MacMillan Bloedel Ltd.	27.93
18	Hiram Walker Gooderham and Worts Ltd.	26.13	General Motors of Canada Ltd.	28.66
19	Domtar Ltd.	26.74	Dominion Foundries and Steel Ltd.	29.29
20	Northern and Central Gas Corpn.	27.34	Norcan Energy Resources Ltd.	29.90

Sources: Financial Post, July 11, 1970, Financial Post, "The Top 300", Supplement, Summer, 1976.  
Statistics Canada, Cat. No. 61-003 various issues.

\* General Motors did not publish financial data when this list was compiled. It would likely have appeared had it done so.

TABLE XIV

AGGREGATE CONCENTRATION  
UNITED STATES AND CANADA

		% manufacturing value added accounted for by the:	
		largest 50 enterprises	largest 100 enterprises
United States	1963	24	32
United States	1966	24	32
United States	1967	25	33
Canada	1968	34	45
Canada	1970	34	45

Source: Department of Commerce, U.S. Bureau of the Census  
(1971), Ch.9, p.6.  
Statistics Canada, Cat. No. 31-402 (1975).



## CHAPTER 2

### ECONOMIES OF SCALE IN MARKETING

#### 2.1 INTRODUCTION

Any resource savings resulting from large-scale marketing activity may be available only to large organizations. If so, the detection of economies of large-scale marketing would constitute the basis for a defence of the large multi-market firm.

Two aspects of marketing are examined in this chapter. Section 2.2 reports the results of a search for economies of scale in advertising. Section 2.3 reports the results of a similar search in the area of export promotion activities.

#### 2.2. ECONOMIES OF LARGE-SCALE PROMOTION

##### 2.2.1 Introduction

There are two potential sources of economies of scale in promotional activity. First, large advertisers may be able to obtain lower rates from the communications media. If these lower rates reflect the resource savings (if any) of servicing one large buyer and if these savings could not be obtained by smaller advertisers buying collectively, they must be credited to the large firm. That is, they will constitute a defence for large size.

Second, there may be economies of scale in the production of advertising information itself. Specifically, doubling the number of advertising messages produced may more than double the awareness of, or response to, these messages on the part of consumers. Two producers of a given product will find that, in this case, a given advertising expenditure induces a greater response from consumers when it consists of repetitive messages regarding one brand name than is elicited by half as many messages about each of two brands. This provides an incentive either to merge or to share the same brand name. The sharing of a single brand name by two producers might be expected to entail significant transactions costs. Since neither producer bears the full cost of a diminution of the quality of the branded product, there will be an incentive for both participants to do so. The costs of enforcing an agreement on the many facets of product quality may induce these producers to merge rather than advertise co-operatively.

Economies of scale in consumer response to advertising messages should result in a reduction in the number of brands available. It does not explain the emergence of the multi-market firm (this is explained by a promotional economy of a different nature). If the consumer carries at least some of his brand recognition or acceptance from product to product (product market to product market) an advertiser can obtain a given level of awareness of two products with less

than twice the expenditure needed to produce that level of awareness of one product. Applying a common trademark to a line of  $n$  appliances will allow its producer to achieve a given level of acceptance of each of these  $n$  appliances with an expenditure less than  $n$  times the amount required to achieve the same level of acceptance of one appliance. The economies of the common trademark are limited only by the consumer's willingness to transfer his acceptance of that trademark to an additional product.

The movement of consumers from market to market also explains the advantage of the national brand. Media rate structures notwithstanding, the advantage of advertising the same brand in two geographic markets arises when buyers in one market transfer to another and take their familiarity with a given brand with them.

The advantages of a common trademark can be obtained either by a large, multi-market firm or by smaller, single product firms employing a common trademark. There are a number of licencing and joint venture arrangements which would enable smaller firms to take advantage of the economies of common trademarks. The proposed joint venture under which General Steel Wares and Canadian General Electric would produce appliances under the Westinghouse trademark is a case in point (Financial Post, November 20, 1976, p.3.) Given the incentive of any one participant in such a collective trademark

agreement to diminish quality at the expense of the other participants, these agreements must contain performance standards and mechanics for their enforcement, and thus might be more costly than mergers as a method of attaining the economies of a common trademark.

The scope of the economies of a common trademark must be relatively limited. First, these economies are important where trademarks are important; that is, for products whose quality is not easily discernible and which are purchased infrequently. Second, they are important for a range of products which appear to the consumer to require similar skills to produce. This would explain why producers of motor vehicles, farm machinery and electrical appliances market a "full line" of products under a common trademark. It also explains the general lack of success experienced by these producers in extending the use of their trademarks much beyond their respective sectors.

#### 2.2.2 Advertising Rate Structures

Most of the debate regarding rate structures has been confined to television advertising rates. In the United States the debate began with assertions that large advertisers were charged lower per-unit rates and these were not reflective of any cost advantages to serving the large buyer (Blake and Blum (1965)). Assertions to the contrary came from Blank (1968) and Peterman (1968) both of whom found that advertising rates actually paid by large and small advertisers did not differ.

A possible resolution of the debate came from Comanor and Wilson (1974) who demonstrated that although large advertisers did not pay lower rates in aggregate, economies of scale of a sort did exist. Specifically, they found that although there is an equiproportionate relationship between the amount advertisers pay for a minute of television time and the number of minutes purchased, the amount paid for a minute of television time on a given program rises less than proportionately with the number of minutes purchased on that program; there is a significant discount on the number of minutes purchased on a given program. Comanor and Wilson conclude that

With such large program discounts, large advertisers could take advantage of these savings more effectively than small advertisers by concentrating their budgets on a small number of programs. That they have chosen not to do so may be due to a decline in the marginal effectiveness of advertising through individual programs and resulting gains from message diversification across programs. Because of large program discounts small advertisers are forced to choose between higher costs by not taking advantage of these discounts and foregoing the gains from program diversification. (1974, pp.59-60)

The practice of purchasing entire programs and advertising a range of products on each program allows the multi-product firm to obtain the benefits of diversification of message sources while retaining the quantity discount. The single-product advertiser can obtain the same diversification and pay a higher rate, or obtain the discount and lose the diversification. There is a clear advantage to either cooperative or multi-product buyers.

To the authors' knowledge the Canadian evidence is in a much more primitive state. Evidence on quantity discounts must come from rate cards which do not necessarily reflect the amounts advertisers actually pay for time. It would seem, however, that quantity discounts actually obtained will be greater than those listed on the rate cards unless negotiated rates are lower across the board. If this is the case the published rates will understate the extent of the discounts available.

The discounts available to large advertisers on the two largest Canadian television networks are illustrated in Tables I and II pages 69-70. The CBC network offers frequency discounts beginning at 3% for purchases of over 13 minutes and rising ultimately to 21% for purchases of more than 208 minutes. Beyond this point frequency discounts are negotiable. CBC also offers continuity discounts of 10% to those purchasing more than two minutes per week for 52 consecutive weeks. Continuity discounts are applied to the net amounts payable after frequency discounts are taken. The combined effect of these two discounts on the prime time cost per minute function for each of the full English and French networks is shown in Table I. The largest advertisers on the English network are offered rates per minute some 30% lower than the rates paid by the smallest advertisers.

The CTV network offers a similar structure of declining per minute rates. Discounts begin with the purchase of 13 announcements. These need not be one minute in length

although this assumption is made in the construction of Table II. A second set of discounts is awarded on the basis of total spending. Spending discounts begin at 3% for expenditures over \$650,000 per year rising to 6% for those over \$1 million per year and ultimately reach 15% for those spending \$2,350,000 or more per year. The net effect of these discounts on the cost-per-minute function for prime time non-Canadian content on CTV is shown in Table II.

The published rate structure clearly indicates that large advertisers pay lower rates per minute of time purchased than do small advertisers. The relevance of this finding to the debate regarding the real economies of large size depends on the answers to the following questions. First, are the rates that are actually paid similar to the published rates? Second, if large advertisers actually pay lower rates than small advertisers, are these rate differences reflective of real cost savings? Third, if rate differences do exist and reflect real cost savings, can they be obtained with equal efficacy by both large firms and small firms buying advertising collectively? If the answer to the first two questions is "yes", and the answer to the third is that co-operative buyers incur costs not incurred by the single large buyer, then economies of large-scale buying of advertising must be a real advantage of large firm size and thus constitute a defence for it. In reaching this conclusion one is necessarily treating advertising information as simply one more service. If it is viewed as inherently 'unworthy' then any advantages the large firm may have in its production are irrelevant.

### 2.2.3 Economies of Scale in the Production of Advertising Information

Most of the evidence on economies of scale in the production of advertising information is on the response of the consumer to repetitive messages regarding a single brand. These economies are due to the effect of repetition on the number of individuals receiving the message and the fraction of those who have received it who are aware of it. Simon (1969) and Schmalensee (1972) have surveyed the literature on repetition and awareness and found general evidence of decreasing returns to scale. Comanor and Wilson maintain that there is a threshold effect, that it takes many messages to generate awareness on the part of the buyer. This is the same as an indivisibility in production and implies increasing returns to scale.

There is no information on the efficacy of repetition in raising the numbers of people receiving a message; it would appear to be inherently subject to decreasing returns, since the probability of a message being new to a buyer must continuously decline. Although the bulk of the evidence implies decreasing returns, the issue is clearly not resolved.

Scale economies of this type are not responsible for the emergence of multi-market firms. The latter will experience the economies of applying a common trademark over a number of geographic and product markets. The only evidence of the extent of this type of economy is the extent to which trademarks are applied across markets.

TABLE I

## COST OF CBC PRIME TIME PER MINUTE, 1975

Number of Minutes	% Discount	ENGLISH NETWORK				FRENCH NETWORK			
		Gross Cost	Cost Net of Frequency Discount	Cost Net of Continuity Discount	Cost per Minute	Gross Cost	Cost Net of Frequency Discount	Cost Net of Continuity Discount	Cost per Minute
1	0	\$ 5,664	\$ 5,664	\$ 5,664	\$5,664	\$ 1,681	\$ 1,681	\$ 1,681	\$ 1,681
13	3	73,632	71,423	71,423	5,494	21,853	21,197	21,197	1,631
26	6	147,264	138,428	138,420	5,324	43,706	41,084	41,084	1,580
52	9	294,528	268,020	268,020	5,154	87,412	79,545	79,545	1,530
104	15	589,056	500,698	450,628	4,333	174,824	148,600	133,740	1,286
208	21	1,178,112	930,708	837,638	4,027	349,648	276,222	248,600	1,195

Source: Canadian Advertising Rates and Data, September 1975.

TABLE II

COST OF CTV PRIME TIME, NON-CANADIAN CONTENT PER MINUTE, 1975.

Number of Announcements	Rate per Minute	Minutes Per Year	Gross Cost	Cost Net of Expenditure Discount	Cost per Minute
1	6,137.25	1	6,137.25	6,137.25	6,137.25
13	5,970.25	13	66,613.25	77,613.25	5,970.25
26	5,594.50	26	145,457.00	145,457.00	5,594.50
51	5,427.50	51	276,802.50	276,802.50	5,427.50
104	4,801.25	104	499,330.00	499,330.00	4,801.25
208	4,801.25	208	998,660.00	968,700.20	4,657.21
312	4,801.25	312	1,497,990.00	1,348,191.00	4,321.13

Source: Canadian Advertising Rates and Data, September, 1975.

An ad hoc glance at the evidence yields the following impressions:

- (a) widely diversified enterprises typically employ a number of trademarks
- (b) trademarks are applied over a relatively limited range of products.

The implication is that the gains from applying a trademark over a number of product markets are relatively small. The gains from applying a common trademark over a number of geographic markets may be larger. This should not imply that gains of this nature can only be achieved by multi-market firms. The licencing option is often available. One is thus inclined to conclude that the economies of multiple trademark applications, which are achievable only by the multi-market firm, are very slight.

## 2.3 FIRM SIZE AND ADVANTAGES IN EXPORT PROMOTION

### 2.3.1 The Issue

It is often argued only large firms can engage in export activity. In their submission to the Royal Commission on Corporate Concentration, officers of MacMillan Bloedel argued that

International trade ... has important implications for MB's scale of operations. If MB did not have substantial size, it would not be a major exporter of Canadian products. To be successful in international trade in commodities, a company must have a large volume of its products available for sale. It must also have access to an adequate supply of raw materials, low cost manufacturing facilities, and a large marketing and transportation organization to sell and service a variety of foreign markets. (1975, p.2-6)

The large volume of forest products MB sells enabled the Company to develop a worldwide marketing system at minimum unit sales costs. A complex sales organization of agents and subsidiary companies throughout the world has been created to serve the particular needs of each local market. For example, lumber is sold in ten Eastern American states through a wholly-owned subsidiary with twelve sales offices, eight warehouses and eleven cargo terminals. In the U.K. and Japan, sales and distribution are handled through joint-venture companies with local partners. Pulp and paper products are sold through a sales organization based in Vancouver which uses, where appropriate, agents or subsidiaries in other countries.

MB's network of sales agents and subsidiary companies keeps its head office in continuous contact with markets throughout the world and assists it in making long-term marketing plans in an attempt to maximize mill returns and ensure stability for both mill and customer. New markets can be opened when opportunities develop and existing markets can be expanded and services to them improved. With its existing large marketing network, MB has also been

able to provide marketing services to smaller Canadian companies whose product volumes do not permit development of such a network.  
(1975, p.2-12)

The issues to be resolved, then, are first, whether there is any a priori reason to believe that large firms will have advantages over small firms in export promotion per se, and second, whether there is any evidence of the existence of such advantages. Section 2.3.2 is taken up with the first question and sections 2.3.3 and 2.3.4 with the second.

### 2.3.2 Theoretical Considerations

As discussed in Section 1.3, a large firm will have an advantage over a small firm in any activity, including export promotion, if there are economies of scale in that activity due to the physical indivisibility of one or more inputs with respect to the level of output, or if the activity is subject to scale economies for other reasons (specialization, economies of dimension) and can be traded on the market only by incurring significant transaction costs.

The physical indivisibility of some inputs associated with export promotion is not inconceivable. Time spent dealing with customs officials may, for example, be unrelated to the size of the sale involved. It is difficult, however, to think of an indivisibility of sufficient importance to yield a significant advantage to the large firm. There is a temptation to cite indivisibilities such as the time spent familiarizing

salesmen with the product but these are common to promotional activities in general and would not explain any advantages of the large firm in export activity per se.

There may also be economies of specialization in export promotion. These need not put the small firm at a disadvantage. Given the evidence that there is a well-established market in export management services, the smaller firm can purchase the services it requires in the quantities required from independent specialists. The emergence of a market such as this was predicted by Stigler (1951) and its existence is recognized implicitly by MacMillan Bloedel in the passage of their submission which concluded

With its existing large marketing network, MB has also been able to provide marketing services to smaller Canadian companies whose product volumes do not permit them to develop such a network (1975, p.2-12)

The extent of the market for export management services was noted by Touchie (1974) who observed

... the field of international marketing appears as a natural for specialization. Why, then, are there no organizations which handle the exporting activities and the many complications which dissuade so many businessmen? In the United States such companies not only exist but account for 8% of all U.S. exports....

In the United States the 1,000 existing export management companies share one common trait - they represent U.S. manufacturing businesses in

overseas markets and invest heavily in the international potential of their product lines.  
(1974, p.66)

Given the absence of significant physical indivisibilities and the apparent presence of a widespread market in export management services, the a priori expectation must be that large firms will hold little if any advantage over small firms in export activity per se and that, as a consequence, the former will not be observed exporting a different proportion of their sales than the latter. Regrettably nothing is quite this simple. In the foregoing, it was assumed implicitly that the price at which output can be sold is the same in both domestic and foreign markets. It then follows that the small firm which suffers general rather than export-specific cost disadvantages will, if it survives, export the same fraction of its output as the larger firm. If the domestic price were to exceed the world price and the effect of the general cost disadvantage (due, for example, to diseconomies of small scale promotion or production) suffered by the small firm is to raise its per unit cost above the world price but not above the domestic price, it will survive but export nothing. In this case one would observe: (a) an export:sales ratio of zero for all firms with unit costs above the world price and (b) positive and similar export:sales ratios for all firms with unit costs below the world price. Although it is difficult to imagine groups (a) and (b) coexisting in the domestic market for any length of time, data observed on an industry basis at any point

in time might show the firm size export:sales ratio as a step function. As industry definitions become wider one is more likely to observe a combination of several step functions and interpret it as a continuous relationship between size and export intensity.

### 2.3.3 Existing Empirical Evidence

One method of inferring whether large firms have an advantage relative to small firms in export promotion per se is to examine the relationship between firm size and the fraction of sales devoted to exports. If export intensity increases with firm size the reason may be that the large firm has a relative advantage in export activity. Some evidence on the relationship between firm size and export intensity in a Canadian context can be found in an ambitious and interesting study by Drinkwalter (1971). Employing a sample of 155 Canadian manufacturing firms the author estimated a relationship between the export:sales ratio of a firm and (i) the number of product and process patents obtained in past periods; (ii) the age of the firm; (iii) the firm's rate of return on equity; (iv) the total assets (size) of the firm; (v) the age of the management and (vi) the education of the management.

Drinkwalter finds (p.103) a positive relationship between firm size (total assets) and export intensity. Caution should be taken, however, not to rely too heavily on these results. The first reason for this is that the author omitted

all non-exporters from his regressions. As Hartley (1976, pp.24-5) has noted, when the model

$$y = X\beta + u$$

is estimated with the requirement that  $y > 0$ , the error term  $u$  must satisfy the inequality

$$u_i > -X_i\beta > -\infty$$

and will as a consequence have a positive expectation. This results in  $\hat{\beta}$  values which are biased and inconsistent.

A second reason is that, while the author correctly recognizes the simultaneity problem which results from the possibility that a firm can be large because it has a high export:sales ratio, it is not clear in a cross-section model such as this that any of the variables on the right hand side are exogenous. His simultaneous model has little, if any, more claim to be the "correct" model than his single equation model (p.71). The latter indicates no relationship between export intensity and size.<sup>1</sup>

In summary, Drinkwater's work provides some indication, but one which is by no means overwhelming, of a positive relationship between export intensity and firm size.

#### 2.3.4 New Empirical Evidence

The relationship between firm size and export intensity can be inferred from estimates of the simple model

$$X_{it} = \sum_{j=1}^k b_{1j} D_j S_{it} + \sum_{j=1}^k b_{2j} D_j S_{it}^2 + \varepsilon_{it} \quad (1)$$

where  $X_{it}$  = exports of the  $i^{th}$  firm during year  $t$

$S_{it}$  = sales of the  $i^{th}$  firm during year  $t$

$D_j$  = 1 if the  $i^{th}$  firm is assigned to the  $j^{th}$  industry  
= 0 otherwise

This model is estimated by weighted least squares.

The weights employed are sufficient to ensure an homoskedastic error term. A weight of  $(S_{it})^{-1}$  on each variable is equivalent to dividing each term by sales and estimating the more familiar ratio model. In the majority of cases this weight is, in fact, employed.

The dummy variables allow the intercept term,  $b_1$ , and the slope coefficient,  $b_2$ , to differ from industry to industry. The number of dummies employed varies between zero and twelve depending on the data set involved.

The important coefficient is  $b_2$ . If it is significantly greater than zero, exports rise more than proportionately with firm size.

Two sets of data are employed. The first set consists of observations taken on 127 firms during the years 1972 and 1973 and was obtained on a confidential basis from the Capital Expenditures Division of the Department of Industry, Trade and Commerce. The firms sampled were respondents to the bi-annual capital expenditures survey. They constitute a representative sample in terms of their investment activity.

In terms of their exporting activities they may not be representative of Canadian firms in general.

The second set of data consists of observations taken on 324 firms during the year 1973. This sample amounts to a non-random drawing from a universe including all non-financial industrial companies with assets of more than \$5 million which are incorporated in Canada and whose voting shares are more than 50% owned by a non-resident corporation. The sample is non-random because it includes firms which have responded voluntarily to an annual survey conducted by the Department of Industry, Trade and Commerce.<sup>2</sup> It is assumed here that there is no response bias so that inferences regarding the population of foreign-owned firms in Canada may be made. If there are systematic differences in the behaviour of foreign and domestically-owned firms, inferences regarding the general effect of size on export intensity can not be made on the basis of this sample. A discussion of the extent to which the results obtained here can, in fact, be generalized appears later in the text.

When applied to the first data set model (1) takes on the specific form

$$X_{it} = \sum_{j=1}^{12} b_{1j} D_j S_{it} + b_2 S_{it}^2 + b_3 F_i S_{it} \quad (2)$$

where  $F_i = 1$  if the  $i^{\text{th}}$  firm is foreign owned, zero otherwise.

The intercept is allowed to take on a different value for each of the 12 industry classifications to which the sample firms could be assigned. These classifications are loosely based on the Standard Industrial Classification and are (with their  $j$  value given in brackets): (1) electrical and electronic products; (2) chemical products; (3) glass and glass products; (4) rubber and textile products; (5) iron and steel mills and other metal refiners; (6) forest products; (7) food, beverage and tobacco products; (8) metal and asbestos mines; (9) coal mines; (10) oil refineries; (11) crude oil and gas; (12) aircraft and parts, automobiles and parts, bus and truck bodies, railway rolling stock and metal fabricators.

The sign of coefficient  $b_3$  will reflect the effect of foreign ownership on a firm's export:sales ratio. Foreign ownership may affect the proportion of sales exported in either of two ways. It is alleged by some observers that because Canadian subsidiaries are constrained by foreign parents to avoid competing with the latter in export markets, foreign-owned firms will export a smaller proportion of their sales than will Canadian-owned firms. Alternatively, a foreign-owned firm may have access to the parent's marketing organization and thus be able to avoid precisely the type of indivisibilities which, it is argued above, reduced the attractiveness of export activity to a small firm.

Estimates of coefficients  $b_{1j}$ ,  $j=1 \dots 12$ ,  $b_2$  and  $b_3$  are reported in Table III. The estimates were obtained by

weighing all variables by  $(S_{it})^{-.75}$  and applying ordinary least squares. While this procedure gives slightly more weight to relatively large observations than deflation by  $S_{it}$ , it was found that heteroskedasticity was removed by the former weighing system but not by the latter.<sup>3</sup>

At conventional significance levels one can not reject the null hypothesis that, holding industry and ownership effects constant, firm size exerts no effect on the proportion of sales exported. Large firms are not more "export oriented" or "export intensive" than small firms.

With regard to foreign ownership one finds that at conventional significance levels one can reject the null hypothesis that ownership exerts no effect on export intensity in favour of the alternative hypothesis that foreign owned firms export a greater proportion of their output than do domestically owned firms. The effect of ownership on export intensity is, however, confined to the resource sector.<sup>4</sup> Ownership exerts no effect on the exports: sales ratio of firms operating in the manufacturing sector.<sup>5</sup> This result is understandable since a good many firms in the resource sector were formed with the precise objective of exporting raw materials required by a foreign owned parent.

Interval estimates of industry weighted average export:sales ratios are reported in Table IV. Clearly, the overwhelming proportion of interfirm differences in export intensity are due to the different characteristics of the industries

in which these firms operate. Within the resource sector, industry weighted average export: sales ratios range from .37 for crude oil and gas to .90 for coal and none of the confidence intervals includes zero. Within the manufacturing sector only the iron and steel and other metal refiners and aircraft, autos, etc. industries have weighted average export:sales ratios which differ significantly from zero. The latter result is most likely due to the trade in automobiles and parts which resulted from the Auto Pact.

Observations in the second data set are allocated to nine industries which are: (1) mining and primary metals; (2) gas and oil; (3) machinery and metal fabricating; (4) transportation equipment; (5) electrical products; (6) chemicals; (7) food and beverage; (8) pulp and paper; (9) other manufacturing.

The specific form of the model applied to the data is either

$$X_{it} = \sum_{j=1}^9 b_{1j} D_j S_{it} + b_2 S_{it}^2 \quad (3)$$

or

$$X_{it} = \sum_{j=1}^9 b_{1j} D_j S_{it} + \sum_{j=1}^9 b_{2j} D_j S_{it}^2 \quad (3a)$$

Equation (3) constrains  $b_2$ , which reflects the effect of firm size on export intensity, to be the same in all industries while (3a) allows it to differ across industries. Estimation of (3a) is equivalent to estimating the basic model separately for each of the nine industries involved. Results obtained using

TABLE III

Estimates of Coefficients of Model (1)

<u>Coefficient*</u>	<u>Estimated Value</u>	<u>Standard Error</u>	<u>t-value</u>
$b_{11}$	.080	.059	1.36
$b_{12}$	.065	.062	1.05
$b_{13}$	-.031	.065	- .48
$b_{14}$	-.0007	.076	- .009
$b_{15}$	.267	.047	5.68
$b_{16}$	.568	.038	15.10
$b_{17}$	.060	.048	1.24
$b_{18}$	.718	.044	16.28
$b_{19}$	.896	.154	5.80
$b_{110}$	.037	.055	.67
$b_{111}$	.369	.073	5.04
$b_2$	-.000015	.000026	- .58
$b_3$	.117	.034	3.48

$$\bar{R}^2 = .57 \quad N = 231 \quad F(13,217) = 24.8$$

\*  $b_{1j}$ ,  $j=1...12$  are industry intercepts. An industry definition corresponding to each value of  $j$  is given in Table IV.

TABLE IV

Interval Estimates of Average Exports:  
Sales Ratios by Industry \*

Industry Group	$V_1$ and $V_2$ such that $P(V_1 < (\bar{X}/S) < V_2) = .95$		
	<u><math>V_1</math></u>	<u><math>(\bar{X}/S)</math></u>	<u><math>V_2</math></u>
1. Electrical and electronic products	-.034	.080	.194
2. Chemical products	-.057	.062	.187
3. Glass and glass products	-.158	-.031	.096
4. Rubber and textile products	-.150	-.0007	.148
5. Iron and steel mills and other metal refiners	.175	.267	.359
6. Forest products	.494	.568	.643
7. Food, beverage and tobacco products	-.034	.060	.154
8. Metal and asbestos mines	.632	.718	.804
9. Coal mines	.594	.900	1.20
10. Oil refineries	-.145	-.037	.071
11. Crude oil and gas	.226	.369	.512
12. Aircraft and parts, automobiles and parts, bus and truck bodies, railway rolling stock and metal fabricators	.240	.356	.472

\* Averages are weighted according to the scheme described in the text, page 81.

specification (3a) are reported in this form.

When foreign owned firms report their exports they report: (i) total exports, (ii) exports to parents and affiliates and (iii) exports to arm's length customers. It is the latter category which will most likely reflect the general effect of firm size on export intensity. If this sample is to yield any inferences about a population including both foreign- and Canadian-owned firms, they will be obtained from the relationship between firm size and exports to arm's length customers. Since the effect of firm size on the proportion of sales accounted for by transfer to foreign affiliates is also of more than passing interest, models (3) and (3a) are estimated with three different dependent variables which are  $X_{it}$  which has already been defined,  $P_{it}$  which is the sales of the  $i^{th}$  firm to parents and affiliates abroad during year  $t$  (1973), and  $C_{it}$  which is the sales of the  $i^{th}$  firm to arm's length customers abroad during year  $t$ .  $P_{it}$  and  $C_{it}$  sum to  $X_{it}$ .

Estimates of (3) and (3a) were obtained by weighting each of the variables involved and applying ordinary least squares. When a weight of  $(S_{it})^{-1}$  is employed one can not reject the null hypothesis of homoskedastic residuals using a Goldfeld-Quandt (1965) F test. The estimates reported in Tables III and IV employ a weight of  $(S_{it})^{-1}$  and are thus identical to those obtained with the so-called "ratio" model.

Estimates of model (3) are reported in Table V. The  $b_{1j}$ ,  $j=1...9$  reported are the average export:sales ratios

for the firms in each of the nine industry groups. Notice that, for each  $j$ , the  $b_{1j}$  estimates obtained when dependent variables are  $P_{it}$  and  $C_{it}$  sum to the  $b_{1j}$  estimate obtained when the dependent variable is  $X_{it}$ .

Of principal interest is coefficient  $b_2$  which is the average effect of a change in sales on the exports:sales ratio. When the dependent variable is  $(X_{it})$ , coefficient  $b_2$  is positive but not statistically significant. On average, exports rise proportionally with sales, no more, no less. This aggregate result masks some rather interesting disaggregated results. When the dependent variable is  $P_{it}$ ,  $b_2$  is positive and statistically significant. When the dependent variable is  $C_{it}$ ,  $b_2$  is negative and marginally significant. These results imply that as firm size increases the proportion of sales going to foreign parents and affiliates increases while the proportion of sales going to foreign arm's length customers decreases. The net effect is that total exports as a proportion of sales do not change with firm size. One must conclude that the larger a foreign owned firm becomes the more closely it is integrated with affiliates abroad.

Estimates of  $b_2$  reported in Table V represent the average effect of firm size on the export:sales ratio. As in the case with any average, it may be materially affected by one very large or very small observation. In the present context, the conclusion reached above regarding the effect of firm size on the export:sales ratio may not hold for all nine industries.

TABLE V

Model (3)

<u>Coefficient</u>	<u>Dependent Variable</u>		
	$X_{it}$	$P_{it}$	$C_{it}$
$b_{11}$	.474 (11.11)	.325 (8.57)	.149 (5.56)
$b_{12}$	.115 (2.30)	.069 (1.55)	.046 (1.49)
$b_{13}$	.079 (2.28)	.055 (1.77)	.025 (1.15)
$b_{14}$	.410 (7.18)	.168 (3.32)	.242 (6.83)
$b_{15}$	.103 (2.27)	.044 (1.11)	.058 (2.08)
$b_{16}$	.092 (2.30)	.053 (1.50)	.039 (1.56)
$b_{17}$	.076 (2.00)	.030 (.89)	.046 (1.95)
$b_{18}$	.443 (9.21)	.258 (6.04)	.185 (6.21)
$b_{19}$	.091 (2.20)	.042 (1.15)	.049 (1.91)
$b_2$	.0032 (.69)	.0083 (2.02)	-.0053 (1.79)
F(d.f.)	14.34 (9,255)	7.74 (9,255)	6.36 (9,255)

t statistics in brackets.

TABLE VI

Model (3a)

Dependent Variable and Coefficients\*

j	$X_{it}$		$P_{it}$		$C_{it}$		Degrees of Freedom
	value	$b_{1j}$	$b_{2j}$	$b_{1j}$	$b_{2j}$	$b_{2j}$	
1	.541 (4.62)	-.141(10 <sup>-5</sup> ) (.73)	.471 (4.44)	-.309(10 <sup>-5</sup> ) (1.75)	.070 (0.94)	.168(10 <sup>-5</sup> ) (1.36)	27
2	.111 (2.72)	.457(10 <sup>-7</sup> ) (0.70)	.096 (2.34)	-.180(10 <sup>-9</sup> ) (.002)	.015 (1.23)	.459(10 <sup>-7</sup> ) (2.42)	21
3	.056 (3.45)	.419(10 <sup>-6</sup> ) (3.06)	.034 (2.30)	.428(10 <sup>-6</sup> ) (3.45)	.022 (2.29)	-.946(10 <sup>-8</sup> ) (0.11)	42
4	.412 (6.01)	.282(10 <sup>-7</sup> ) (0.43)	.145 (2.23)	.132(10 <sup>-6</sup> ) (2.10)	.266 (4.42)	-.103(10 <sup>-6</sup> ) (1.78)	17
5	.111 (2.65)	-.743(10 <sup>-7</sup> ) (0.26)	.056 (1.73)	-.601(10 <sup>-7</sup> ) (.27)	.055 (2.95)	-.142(10 <sup>-7</sup> ) (0.11)	24
6	.096 (2.55)	-.279(10 <sup>-7</sup> ) (0.77)	.066 (2.08)	-.103(10 <sup>-6</sup> ) (0.34)	.030 (1.84)	.750(10 <sup>-7</sup> ) (0.47)	31
7	.105 (3.03)	-.334(10 <sup>-6</sup> ) (1.05)	.052 (1.91)	-.188(10 <sup>-6</sup> ) (0.76)	.053 (2.53)	-.146(10 <sup>-6</sup> ) (0.75)	35
8	.443 (3.86)	.268(10 <sup>-7</sup> ) (0.03)	.299 (3.03)	-.399(10 <sup>-6</sup> ) (0.52)	.144 (2.26)	.425(10 <sup>-6</sup> ) (0.86)	21
9	.099 (2.65)	-.893(10 <sup>-7</sup> ) (0.25)	.043 (2.24)	.763(10 <sup>-7</sup> ) (0.43)	.057 (2.39)	-.166(10 <sup>-6</sup> ) (0.75)	29

\* t statistics in brackets

To investigate this possibility it is necessary to allow  $b_2$  to differ from industry to industry. Model (3a) achieves this purpose. Estimates of model (3a) are reported in Table VI. The intercepts are again, industry export:sales ratios and, of course, do not differ from those reported in Table VI. Estimates of  $b_2$  differ widely across industries. When the dependent variable is  $X_{it}$ ,  $b_2$  is insignificant in all but one case, machinery and metal fabricating, in which it is positive. When the dependent variable is  $P_{it}$ ,  $b_2$  is positive and significant in two cases, machinery and metal fabricating and transportation equipment and insignificant in the remaining cases. When the dependent variable is  $C_{it}$ ,  $b_2$  is positive and significant in one case, gas and oil, and negative and marginally significant in another, transportation equipment.

The conclusions reached above can now be made more general. In only one industry, machinery and metal fabricating, does overall export intensity increase with firm size. In this case the increase is due solely to proportionally larger sales to foreign affiliates among the larger firms. The proportion of sales made to arm's length customers does not change with firm size.

In one other industry, transportation equipment, exports to parents and affiliates rise more than proportionally, with sales. This is offset, however, by exports to arm's length customers which rise less than proportionally with sales. The net effect is that total exports increase proportionally

with sales and no more. The positive relationship between firm size and the degree of integration with foreign affiliates which was inferred from the aggregate  $b_2$  estimates reported in Table V is thus also confined to the transportation equipment industry. In no other industry does one observe  $(P_{it}/S_{it})$  rising and  $(C_{it}/S_{it})$  falling as firm size increases.<sup>6</sup>

The conclusion generated by both data sets is that large firms do not export a significantly greater fraction of their sales than do small firms. It thus appears that large firms have no particular advantage in export activity per se. There are, however, a number of qualifications which must be placed on this conclusion. First, the samples are not random and are not necessarily representative of the population of firms operating in Canada. Second, as Drinkwater has suggested, there are a number of other influences on the export intensity of a firm and these are not held constant here: if they were, a relationship between firm size and export intensity might emerge. Third, there is, as Drinkwater has also noted, a simultaneity problem. Given some limitation on the extent of the domestic market, the larger the export:sales ratio of a firm, the larger its sales. Sales and the export:sales ratio are jointly determined. On a cross-section model such as those presented here, it is difficult, if not impossible, to find a variable which is truly exogenous. Despairing, then, of employing the appropriate estimation technique, one is left with the alternative of finding the direction of the

simultaneous equations bias. The latter turns out to be either positive or negative depending on the relative magnitudes of certain coefficients in the larger, simultaneous model. The estimates of the effect of firm size on the export:sales ratio presented here may thus either overstate or understate the true relationship. In the event that it is understated, the possibility arises that the null hypothesis of no relationship between size and export intensity was accepted when it should, in fact, have been rejected. While the likelihood that this is the case is not known, it is cause for caution in interpreting and generalizing the results reported above.

#### 2.3.5 Policy Implications

While they are clearly not conclusive, these results provide no support to those who claim that large firms possess inherent advantages in export activity: there are no grounds for a general merger defence based on the proposition that the resulting increase in size will lead to a more than proportionate increase in exports.

This analysis has concentrated on the alleged advantages of the large firm in export promotion. It should not be taken to indicate that it is the exports themselves which are desirable. It is the attainment of real economies in any activity, whether it be in the promotion of exports, or of domestic sales or, for that matter, in production, which increases the incomes of Canadians. The conclusion reached here

is that, whatever advantages they may have in other areas, large firms appear to have none in export activity.

Given the magnitude of the econometric problems encountered here, the extent of the advantages of the large firm in exporting activity might be better assessed by a study of the market for export management services. This would provide more information about the underlying physical indivisibilities and transactions costs which are fundamental to the problem.

## Notes: Chapter 2

1. Drinkwater also finds that, after dividing his sample into exporting and non-exporting sub-samples, the average size of firms in these two categories did not differ (at the five per cent significance level, two tail t test) in the chemical, electrical, food and textile industries. Average firm size differed between the two categories in the fabricated forest products and ferrous metal industries (pp.130-5). One is tempted to ask whether the latter two industries are likely to be characterized by the type of indivisibilities in export management activities which, it is argued in the text, yield advantages to large firms. An alternative explanation, which is especially attractive in the case of these two industries, is the simultaneous determination of size and export intensity which is also discussed in the text.
2. See Canada Department of Industry, Trade and Commerce (1974) for details.
3. The test for heteroskedasticity employed is that of Goldfeld and Quandt (1965).
4. The resource sector includes: Forestry, Metal and asbestos mines, Coal and Crude oil and gas.
5. The manufacturing sector includes: Electrical and electronic products, Chemical products, Glass and glass products, Rubber and textile products, Iron and steel mills and other metal refiners, Food, beverage and tobacco products, Oil refiners and Aircraft and parts, automobiles and parts, bus and truck bodies, railway rolling stock and metal fabricators. The differential effect of ownership was observed by allowing the coefficient of dummy variable F to take on different values in the resource and manufacturing sectors respectively. Thus

$$\begin{aligned}
 X_{it} = & \sum b_{kj} D_j S_{it} + b_2 S_{it} + b_{31} F_i R_i S_{it} \\
 & + b_{32} F_i (1-R_i) S_{it}
 \end{aligned}$$

where  $R_i$  = dummy variable equal to one if the  $i$ th firm is in the resource sector, zero otherwise.

Coefficient  $b_{31}$  was significantly greater than zero while  $b_{32}$  did not differ significantly from zero.

6. A direct test of the integration hypothesis was conducted by estimating the regression

$$(P_{it}/C_{it}) = f_0 + f_1 S_{it} \quad (5)$$

Coefficient  $f_1$  was positive and significant at the five per cent level in the case of the transportation equipment industry and at the ten per cent level in the case of the machinery and metal fabricating industry. It was negative and significant at the ten per cent level in the chemicals and mining and primary metals industries.

## ECONOMIES OF SCALE IN FINANCIAL ACTIVITY

## 3.1 INTRODUCTION

Does an increase in firm size result in a less than proportionate increase in the resources required to facilitate its financial activities? This chapter examines the effect of firm size on the cost of

- (i) assembling a stock of capital ("raising capital")
- (ii) allocating capital among various investment opportunities
- (iii) bearing risk.

Regarding the first, the argument is that there may be physical indivisibilities in the process of raising capital so that the resources required to raise \$100 million do not differ appreciably from those required to raise \$10 million. If there are significant transaction costs borne by small firms in achieving these economies by raising capital jointly, a real advantage accrues to the large firm.

In Section 3.2 some indirect evidence on the advantages of size in the assembly of capital is examined. Much of 3.2 is taken up with a discussion of the merits of employing indirect evidence. It is concluded that a number of indirect tests are ambiguous, at best, in their implications. Section 3.2 therefore provides more in the way of guidance for future research than of substantive conclusions.

The second argument is that a large firm can allocate a given stock of capital among alternative investment opportunities at a lower cost than is incurred by a small firm. This will occur if the large firm has a greater range of internal reinvestment opportunities and participation in the capital market by individuals entails significant transactions costs. Owners of small firms will incur the costs of participating in the capital market each time they wish to respond to changing investment opportunities while owners of a large firm will not. The efficiency and breadth of the internal capital market provided by the large firm are investigated in Section 3.3.

The third argument is that, for an individual, the ownership of a share in a large firm is a more efficient mechanism for risk reduction than is the ownership of an interest in a number of small firms. Some evidence on this issue is assembled and evaluated in Section 3.4. It is found that big firms do not appear to have achieved the insulation of their rates of return from the business cycle which could have been achieved by an individual diversifying his own portfolio. They are not, in this sense, less risky and it is difficult to see how, in the light of these results, they can be touted as being the low cost vehicle for risk reduction.

In each of the next three sections, the indirect tests for the existence of economies of scale in financial activities are subject to considerable criticism. This criticism should not be taken to imply that some of the more direct

tests are without ambiguity. They are not. Any direct evidence which may be unearthed should be treated to the same theoretical scrutiny which has been applied to the evidence presented here.

### 3.2 INDIRECT EVIDENCE ON THE RELATIONSHIP BETWEEN FIRM SIZE AND THE COST OF RAISING CAPITAL

#### 3.2.1 Introduction

The best way to tackle the problem of the relationship between firm size and the value of the resources required to assemble a given amount of capital is to gather direct evidence on the costs of participating in the capital market-- flotation costs for example- and of the rates of return required to induce investors to hold the obligations of firms of various sizes. Although such information exists, it was not available to the authors. As an alternative some indirect evidence was examined. The evidence consisted principally estimates of the relationship between firm size and rate of return. The bearing that the firm size - rate of return relationship has on the relationship between firm size and the cost of raising capital is explained in the theoretical section which follows. Section 3.2.3 contains a summary of the firm size - rate of return relationship observed by other, largely American and British investigators. Estimates of this relationship employing two different sets of Canadian data are reported in Sections 3.2.4 and 3.2.5.

Indirect evidence of the relationship between firm size and the cost of assembling capital can also be obtained by examining the relationship between firm size and dividend payout and financial leverage ratios. Theoretical expectations regarding the relationship between firm size and various

financial ratios appear in the next section. Estimates of these relationships are reported in Section 3.2.7.

### 3.2.2 Theoretical Foundations

Baumol (1959) has suggested that, if there are costs associated with the assembly of large blocks of capital, holders of small blocks of capital (small firms) would be able to undertake investments requiring large blocks of capital only by incurring these assembly costs. Holders of large blocks of capital (large firms) will be able to undertake investments requiring either large or small amounts of capital without incurring these costs. Under these circumstances, if the rate of return to investments requiring small amounts of capital exceeds the rate of return to investments requiring large amounts of capital, holders of large blocks of capital (large firms) would engage in a series of small investments. Capital would flow out of large investments and into small ones until the differential is eliminated. The rate of return on investments requiring small amounts of capital can not, as a consequence, exceed the rate of return on investments requiring large amounts of capital for any length of time. If, on the other hand, the rate of return on investments requiring large amounts of capital exceeds the rate of return on investments requiring small amounts of capital, holders of the latter (small firms) can take advantage of this differential only if they are prepared to incur the higher per unit costs of assem-

bling a large block of capital. For this reason a difference in the two rates of return equal to the cost of assembling a large block of capital will persist. One therefore expects the rate of return to large firms (large blocks of capital) to exceed the rate of return earned by small firms, by the amount of the cost of assembling a large block of capital, on a continuing basis. Hall and Weiss (1967) called this difference the "capital requirements barrier to entry".

Baumol's conjecture translates into the testable hypothesis that, ceteris paribus, the rate of return increases with firm size until the point at which the amount of capital involved is so large that "no larger amount can open up more lucrative returns in any industry" is reached. The difference in the rates of return to large and small firms is, it is argued, independent of any other differences which may arise due, say, to economies of scale. That is, it will exist over time between large and small firms both of which are optimally scaled. It reflects the height of the so-called capital requirements barrier to entry.

Regrettably any test of this hypothesis is doomed to be inconclusive. There are two major reasons for this. First, the outcome of the test would seem to depend on the nature of the costs which are alleged to have the effect of foreclosing large investments to small firms. For purposes of illustration assume that a "large" investment yields a stream of  $P_L$  dollars per year per dollar invested while a "small" investment yields a stream of  $P_S$  dollars per year per

dollar invested.  $P_L$  exceeds  $P_S$  but by incurring costs of  $C$  per year per dollar invested "small" investors can participate in "large" investments. One would expect them to do so as long as  $P_L - P_S \geq C$ . Arbitrage between small and large projects ceases when the average differential in the returns to small and large investments is just equal to the cost of participating in these large projects. One would then observe two groups of firms. "Small" firms would be earning an observed return of  $P_S$ . "Large" firms would be earning an observed return of  $P_L - C = P_S$ . There will be no difference in rates of return provided the costs incurred in participating in large investments are included in the rate of return calculation of the "large" group. It would seem, therefore, that Hall and Weiss are testing two hypotheses. The first is that there are barriers or costs incurred in assembling large blocks of capital and the second is that these costs are not deducted before the accounting rate of return is calculated. They are testing an hypothesis about accounting treatment (do we observe  $P_L - C$  or  $P_L$ ?) in conjunction with their test for the existence of capital requirements barriers to entry.

The problems do not disappear if the cost incurred by small firms in participating in large projects is prohibitive so that there is no movement from the small to the large firm group. One then observes  $P_L$  and  $P_S$  but, again, there is a good reason to believe they will not differ. If large firms have enduring advantages that small firms can not overcome, one would expect these advantages to be reflected in the value

the market places on the large firm. The advantages of the large firm will be capitalized and, again, observed rates of return will not differ. Any differences which are observed indicate more about the extent to which accounting data reflect underlying market valuations than about the advantages one firm has over another.

These considerations imply that, though there may be a distinct relationship between firm size and rate of return, it is unlikely to be observed. The results of attempts to verify empirically the existence of such a relationship will therefore be ambiguous at best. While the discovery of a positive relationship between firm size and rate of return is supportive of the hypothesis that there are non-trivial costs involved in the assembly of large sums of capital, the discovery that there is no such relationship is, for the reasons given above, insufficient to reject this hypothesis.

Some investigators have argued that any relationship between firm size and rate of return which is observed may be due to economies of scale in production rather than the capital requirements barrier to entry. Hall and Weiss make a specific effort to avoid this ambiguity by confining their analysis of the size-rate of return relationship to firms which had, in their view, exhausted the economies of scale in production. Before adopting an alternative such as this it would seem productive to explore the conditions under which one might actually expect economies of scale in production to result in a persistent relationship between firm size

and rate of return.

Consider, for example, an industry characterized by increasing returns to scale in the production of an homogeneous product. The firms involved sell at a common price under a market sharing agreement. That this could lead to the observation of a relationship between firm size and rate of return can be illustrated algebraically. Given the market demand schedule

$$P = a - bQ$$

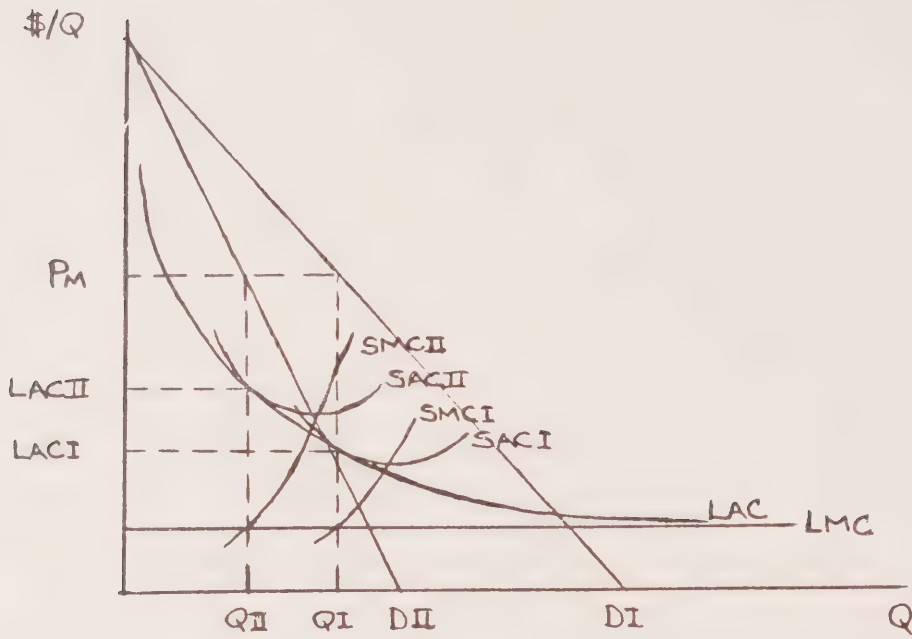
and the long-run total cost function

$$C = d + eQ$$

and firms I and II which, by agreement, supply  $3/4$  and  $1/4$  of market demand respectively, independent profit maximizing behaviour implies a common industry selling price of  $(a + e)/2$ . The output of firm I  $(3(a - e)/8b)$  is three times as large as that of II and its per unit fixed costs  $\{d/[3(a - e)/8b]\}$  are one-third as high. Firm I earns greater per unit profits and a higher rate of return than does the smaller firm I. This result is illustrated in Figure I.

The problem with this result is that there is no reason to expect it to prevail over a long period of time. In this case firm II has an incentive, in the long-run, to expand and bargain for an increased share and it may be in the interest of firm I to accept this. In this simple model a mutually beneficial arrangement would be to produce the same total output  $(Q_I + Q_{II})$  in Figure I) from a single plant. In

Figure I



more complex models different types of rationalization would be observed. In equilibrium, then, one would not expect to observe differences in profit rates within an industry which are due simply to differences in scale.

Comanor and Wilson (1969) have argued that, in industries in which the product can be differentiated, small firms may choose to advertise less and to charge a lower price. Such behaviour is quite consistent with profit maximization under these circumstances and has been analyzed in detail by Dorfman and Steiner (1954). Comanor and Wilson appear to argue that this behaviour implies that larger firms selling at higher prices will earn a higher rate of return than smaller firms. This is true, however, only if one ignores advertising expenditures. There is no reason to expect any difference in rates of return if advertising expenditures are properly taken into account.

This theoretical discussion has not provided a particularly auspicious launching for the empirical work which is to follow. It has been concluded that, over the long-term, neither capital requirements barriers to entry, nor economies of scale nor differing advertising intensities need result in the observation of differences in the rates of return earned by large and small firms. The possibility exists, however, that Baumol's conjecture can be tested in other ways. Taken in its most extreme form, it implies that small firms can not raise capital in the market at any price. If this is the case one would expect to observe small firms relying rela-

sources of finance, such as retained earnings. The small firms should then display relatively higher retained earnings: asset ratios and relatively lower dividend payout ratios than larger firms. For similar reasons small firms will also be able to employ less leverage and will therefore report lower debt:asset ratios.

The existence of advantages to large firms in the assembly of capital may be investigated indirectly by searching for:

- (a) A relationship between firm size and rate of return.
- (b) A relationship between firm size and retained earnings: assets ratios.
- (c) A relationship between firm size and dividend pay-out ratios.
- (d) A relationship between firm size and leverage (debt: equity or debt:asset) ratios.

This task is undertaken in the sections which follow.

### 3.2.3 Results Obtained by Other Investigators

As indicated in the previous section the principal analysis of the relationship between firm size and the rate of return employing observations on individual firms was conducted by Hall and Weiss (1967). They found that, among U.S. firms with 1962 assets between \$33 million and \$11 billion, the rate of return on equity increases at a decreasing rate

with firm size (assets). Since firms too small to have optimally scaled plants are excluded from their sample, these authors attribute their observance of a size-rate of return relationship to the existence of a capital requirements barrier to entry.

Other U.S. studies employing grouped data have partially confirmed the Hall and Weiss results. In an examination of Internal Revenue Service size class data, Sherman (1968) found that

... it appears that the profit rate increases with corporate size rapidly at first, then quite slowly or not at all in the larger size classes - but that there is no adequate evidence that it declines after any point. (p.42).

As is illustrated in Table I, the existence of positive relationship between size and rate of return is confined to firms with assets of less than \$100 million. It would be interesting to know the extent to which the relationship estimated by Hall and Weiss is due to the influence of observations in this size range. Their conclusion of continuously increasing rates of return could be an extrapolation based on relatively few observations.

Contradictory findings are reported for the years 1964, 1966, 1968 by Wittnebert (1970). The latter groups all U.S. corporations into four asset classes (0 to \$1 million, 1 to \$9.9 million, 10 to \$99.9 million and over \$100 million) and finds that the rate of return in the smallest size class exceeded the rates of return in the other three classes

TABLE I  
Rate of Return on Equity, Before Tax,  
All U.S. Corporations

Asset Class		
Lower Limit (000\$)	<u>1958</u>	<u>1959</u>
0	-27.3%	-10.4%
25	2.5	5.3
50	6.3	9.2
100	7.8	10.2
250	8.6	10.3
500	9.4	9.8
1,000	10.1	11.4
2,500	10.7	12.9
5,000	10.9	12.8
10,000	11.9	13.1
25,000	11.3	13.1
50,000	11.3	13.8
100,000	11.4	13.3
250,000	10.9	12.2

Source: Sherman (1968) Table 2-5

(which were bunched together) during this period. He finds also that the gap between the rate of return earned by firms in the smallest size class and that earned by firms in the largest size class widened over this period. This occurrence is attributed by Wittnebert to the wider range of capital sources available to small business and to (unspecified) advantages of the small firm in responding to changes in tastes or technology.

Wittnebert conducts no statistical tests so that there is no way of knowing whether the alleged difference in rates of return is statistically significant. A similarly impressionistic analysis was conducted by Thompson (1975) who found that the rates of return earned by different size classes appeared to converge during the 1960's and that there was no visible (not statistical) difference between the rate of return earned by Fortune's 500 during the years 1958 to 1973 and all other U.S. manufacturing corporations (see Table II).

The studies cited above have investigated the relationship between size and rate of return among U.S. corporations as a group. There are two relatively recent studies which employ size class data to examine the relationship between size and rate of return on an industry basis. Comanor and Wilson (1969) were able to establish the existence of a positive (asymptotic) relationship between firm size and rate of return in 29 of 41 U.S. consumer goods industries examined over the period 1954 through 1961. They do not report the level

TABLE II  
Rate of Return on Equity

Year	Fortune's 500	All other Manufacturing firms
1958	9.5 %	6.6 %
1959	11.0	8.9
1960	10.1	7.2
1961	9.6	7.2
1962	10.6	7.8
1963	11.1	8.4
1964	12.1	10.4
1965	13.0	13.0
1966	13.2	14.0
1967	11.8	11.6
1968	12.2	11.7
1969	11.5	11.4
1970	9.6	8.6
1971	9.8	10.7
1972	10.9	9.8
1973	13.7	10.3

Source: Thompson (1975) p.57.

of significance at which a relationship can be inferred and one suspects that in a large fraction (as many as 20 of the 29 industries reported in their Table I), it is well in excess of the conventional five per cent level.

Marcus (1969) investigates the relationship between (size class) rate of return and size class midpoint for 118 different U.S. industries observed during the years 1959-1961. Employing pooled time-series-cross-section regressions, Marcus finds a statistically significant relationship between size and rate of return in 35 of 118 cases. In the balance the relationship was either negative or nonexistent.

It is interesting to note, by way of comparison, that of the seven industries for which the Comanor-Wilson size-rate of return relationship can be deemed reliable (the predicted minimum optimal firm size is at least twice its standard error), five were also found by Marcus to exhibit a statistically significant size-rate of return relationship. One must conclude from these studies that, insofar as grouped data are concerned, U.S. investigators have found that the existence of a positive relationship between firm size and rate of return is confined to relatively few industries.

Samuels and Smyth (1968) have investigated the size-rate of return relationship within the context of the U.K. economy. They grouped rate of return observations averaged over the period 1954-1963 into ten asset size classes and found that the coefficient of rank correlation between size

and rate of return was negative and statistically significant at the 10% level (see Table III). The limited evidence available for the U.K. economy thus contradicts the U.S. evidence. One therefore takes an eclectic set of expectations into the investigation of the size-rate of return relationship in the Canadian economy.

Among the few recent studies of the relationship between firm size and financial structure is that of Gupta (1969). Gupta examined the financial data for 13 size classes of U.S. corporations for the taxation year 1961-62. Two of the relationships he investigated are relevant in the present context. First, he found no statistically significant relationship between firm size and rate of return on net worth. Second, he found a negative relationship between firm size and the debt:assets or leverage ratio. The expectation was that, if they have advantageous access to capital markets, larger firms would rely more heavily on both debt and equity and less heavily on retentions than smaller firms. This result, while incomplete, is not consistent with this expectation. Firms in the larger size classes relied less heavily on debt and more heavily on either retentions or equity (stock issues) than did firms in smaller size classes. It would be helpful in resolving this issue if Gupta had examined the relationship between firm size and either the equity:assets or retentions:assets ratio.

TABLE III  
Average Rate of Return by Size Class:  
U.K., 1954-1963

<u>Asset Size Group</u> (£ million)	<u>Profits Before Taxes ÷ Net Assets</u>
65 and over	13.93 %
35-65	16.47
15-35	13.48
10-15	16.09
5-10	15.83
2.5- 5	15.65
1.0-2.5	17.52
.5-1.0	20.39
.25- .5	15.68
under .25	18.70

Source: Samuels and Smyth (1968) p.131.

### 3.2.4 A Model of the Firm Size - Rate of Return Relationship Applied to Firm Level Data

Any investigation of the relationship between the size of the firm and its rate of return will encounter and must resolve the following issues:

- (a) How is firm size to be measured?
- (b) How is rate of return to be measured?
- (c) What is the specific functional relationship between size and rate of return?
- (d) What environmental factors must be held constant in order to isolate this relationship?

Since the advantage of the large firm is supposed to be in the large amount of capital at its disposal, one would expect that if profit rates are to increase with firm size at all they will increase with net assets which reflects the stock of capital controlled by each firm.

In choosing a rate of return one must remember that the purpose of this investigation is to explain the failure (if any) of rates of return to equalize across various firm sizes. To accomplish this it is necessary to know any other reasons why rates of return may fail to equalize. One expects, for example, that capital will flow from opportunity to opportunity until the after-tax rate of return is the same in all. If tax rules differ, before-tax rates of return will not equalize. If the effect of firm size on profit rate is to be

isolated, one must either standardize for interfirm differences in tax rules or work with after tax rates of return,

The rate of return can be calculated as either the ratio of after tax profits to net assets or the ratio of after tax profits to equity (net worth). Application of the reasoning of Modigliani and Miller (1958) leads to the conclusion that the stream of future profit will be discounted at a rate which depends only on the risk associated with that stream. Thus, in a tax free world,

$$V = D + E = A = \frac{P}{k_o} \quad (1)$$

$$k_o = \frac{P}{A} = f(\sigma) \quad (2)$$

where  $V$  = the market value of the firm

$D$  = debt outstanding

$E$  = equity or net worth

$A$  = net assets

$P$  = profits per period before deduction of interest charges

$k_o$  = weighted average cost of capital

$\sigma$  = standard deviation of an unlevered profit stream.

The implication is that the weighted average cost of capital or rate of return on assets will differ from firm to firm only if the variability of an unlevered profit stream differs from firm to firm. Given business risk (operating leverage), the rate of return on assets will, capital requirements barriers notwithstanding, be the same for all size

classes of firms.

If the weighted average cost of capital is to be the same for all firms in a given risk class, the rate of return on equity will depend on both the risk class of the firm and the debt:equity ratio employed. Thus if

$$k_o = i \frac{D}{D+E} + r \frac{E}{D+E} \quad (3)$$

where  $i$  = rate of return on debt

$r$  = rate of return on equity

then

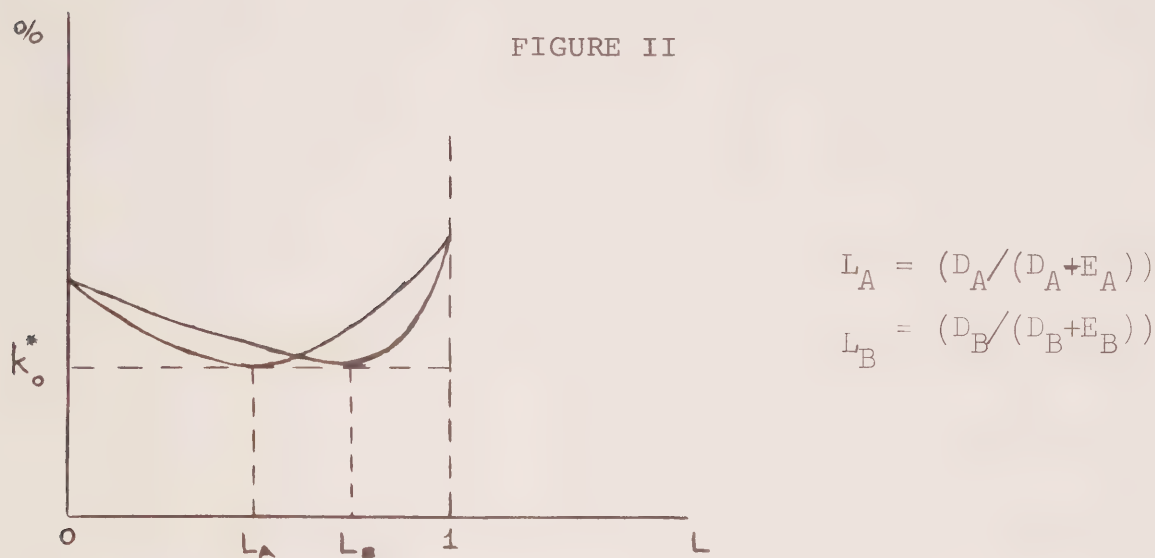
$$r = k_o + (k_o - i) (D/E) = f(\sigma) + (f(\sigma) - i) (D/E) \quad (4)$$

The rate of return on equity is an increasing function of the leverage ratio provided  $k_o$  exceeds  $i$ . As expression (4) indicates, the rate of return on equity will approach infinity as the financing of the firm approaches one hundred per cent debt.

According to this reasoning the rate of return on equity will be different for firms with different business risk,  $\sigma$ , and different leverage ratios even in the presence of perfect capital markets. Interfirm differences in both business risk and leverage must therefore be held constant in any test of the hypothesis that rates of return on equity differ between small and large firms. If this is not done the investigator risks attributing to firm size an effect which is due to risk or leverage.

The constancy of the weighted average cost of capi-

tal implies an indeterminate leverage ratio in the no-tax case and a one hundred per cent leverage ratio when debt is deductible for tax purposes. The conclusions reached above also follow, however, from the more traditional model in which there is a finite leverage ratio at which the weighted average cost of capital is minimized. This is illustrated in Figure II. Two firms, A and B,



achieve the same weighted average cost of capital,  $k^*$ , but, at different leverage ratios,  $L_A$  and  $L_B$  respectively. Given that the minimum attainable weighted average cost of capital and the rate of return on debt is the same for both A and B. The rate of return to equity is an increasing linear function of the optimal leverage ratio. Specifically, since

$$r_A = (k_O^* - iL_A) / (1 - L_A) \quad (5)$$

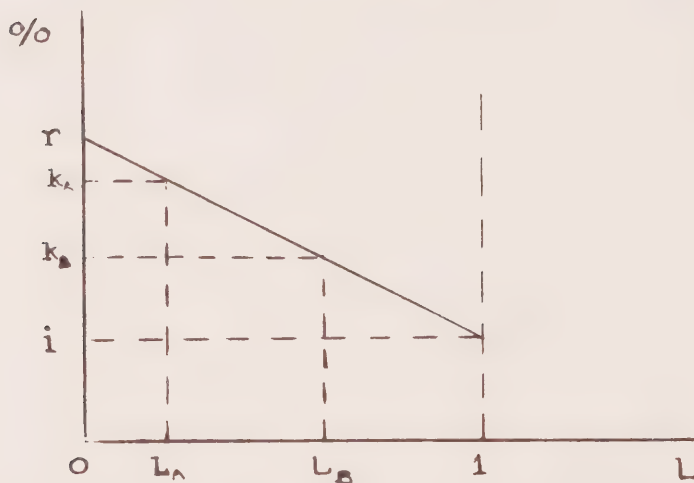
and 
$$r_B = (k_O^* - iL_B) / (1 - L_B) \quad (6)$$

and  $\partial r / \partial L = (k_O^* - i) / (1 - L)^2 > 0$  (7)

$r_B > r_A$  if  $L_B > L_A$ .

Hall and Weiss note that the approach described above has the "unrealistic" implication that highly levered firms will have very high rates of return on equity. They argue that in a competitive capital market rates of return to equity will be equalized and independent of the leverage ratio. A situation such as this is illustrated in Figure III

FIGURE III



The rate of return on equity,  $r$ , is constant and in excess of the rate of return on debt,  $i$ , for all leverage ratios. In this case the rate of return on assets or weighted average cost of capital is a decreasing linear function of the leverage ratio and an increasing linear function of the equity: assets ratio. That is

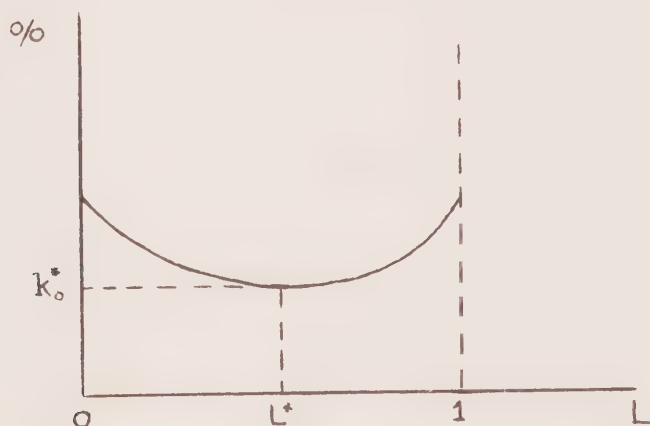
$$k_O = iL + r(1-L) = r - (r-i)L \quad (8)$$

where  $L = (D / (D+E)) = D/V = D/A$

Hall and Weiss correctly conclude from this that they must standardize for differences in the leverage ratio when testing for the effect of firm size on the rate of return to assets. Under these assumptions no such standardization is necessary when testing for the effect of firm size on the rate of return to equity.

If equity holders must be compensated to induce them to accept greater leverage and the rate at which the required compensation increases with leverage is the same for all firms, there will be one weighted average cost of capital function (see Figure IV) and one optimal leverage ratio.

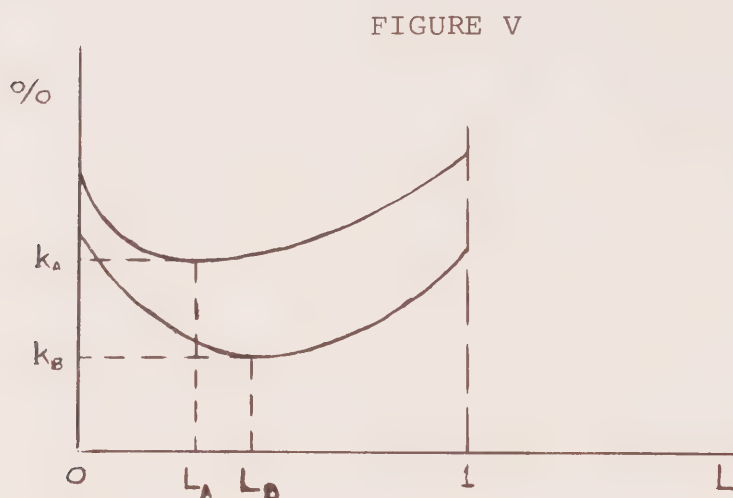
FIGURE IV



Under conditions of equilibrium in perfect capital markets one would expect that the rate of return on assets, the rate of return on equity and the leverage ratio would each be the same for all firms. In this case a test of the effect of firm size on either the rate of return to assets or the rate of return to equity can be conducted without standardizing for differences in the leverage ratio. Standardization for

differences in business risk (the variation in an unlevered profit stream) is still required.

Leverage ratios do not, however, tend to equality even when observed over long periods. If optimal leverage ratios differ in equilibrium it must be the case that the rate at which the compensation required to induce equity holders to accept increased leverage increases with leverage differs from firm to firm. This situation is described in Figure V



For any given leverage ratio the rate of return to equity is lower in firm B than in firm A. Why equity holders would require less compensation from B than from A to induce them to accept the same degree of leverage is unclear, but, if optimal leverage ratios are to differ, this must occur. Under these circumstances neither the rate of return on assets nor the rate of return on equity are unambiguously related either to business risk or the leverage ratio. The influence of these variables on either rate of return is not systematic

and a test for the effect of firm size on rate of return could properly be conducted without standardizing for either of them.

In summary, while a test of the null hypothesis that rates of return either on assets or equity do not differ across firm sizes is not necessarily biased by the omission of (a) a measure of the risk class of each firm, (b) the leverage ratio of each firm and (c) their interaction (see equation (4)), these variables should, if possible, be included in the model. If, as some of the above discussion implies, they are irrelevant, they will be statistically insignificant. While the inclusion of irrelevant variables results in less efficient estimates it will not affect tests of the size - rate of return relationship in any other way.

There are a number of alternative functions which could characterize the relationship between size and rate of return. It may be a discrete relationship implying a step function. This would require the use of dummy variables to indicate both the size of the change in the rate of return and the size of firm at which it occurs. If the relationship is assumed to be continuous it might take one of the following forms:

(a) It could be a linear function such as

$$(\pi/E) = a_0 + a_1 A + \dots \quad (9a)$$

which would imply that increasing one's assets from one to two million dollars yields the same increase in the

rate of return as an increase in assets from five hundred to five hundred and one million dollars.

- (b) It could be a semi-logarithmic function such as

$$(\pi/E) = a_0 + a_1 \ln A + \dots \quad (9b)$$

which implies that a given percentage increase in assets yields the same increase in rate of return for all firm sizes [ $\frac{d\pi/E}{dA/A} = a_1$ ], in the case above, increasing one's assets from one to two million yields the same increase in the rate of return as an increase in assets from five hundred million to a billion dollars.

- (c) It could be a reciprocal function such as

$$(\pi/E) = a_0 - a_1/A + \dots \quad (9c)$$

$$\text{or} \quad (\pi/E) = a_0 - a_1/\ln A + \dots \quad (9c^1)$$

both of which imply that successive percentage increases in assets yield successively smaller increases in the rate of return. Specifically

$$\frac{d(\pi/E)}{dA/A} = a_1/A$$

in the case of (9c) and

$$\frac{d(\pi/E)}{dA/A} = a_1/(\ln A)^2$$

in the case of (9c<sup>1</sup>). Hall and Weiss adopted (9c<sup>1</sup>) arguing that the effect of size on rate of return is best expressed in percentage terms and that this effect decreases as firm size increases, approaching a<sub>0</sub> assymp-

totically. Either (9c) or (9c<sup>1</sup>) will serve this purpose.

(d) It could be a logarithmic reciprocal such as

$$\ln (\pi/E) = a_0 - a_1/A + \dots \quad (9d)$$

which implies that the rate of return rises with firm size initially at an increasing rate and subsequently at a decreasing rate approaching maximum value of  $e^{a_0}$  asymptotically.

Regardless of which of alternatives (9a) ... (9d) best describe the relationship between firm size and rates of return, the latter can be observed properly only when the influence of other sources of interfirm differences in the rate of return are held constant. In the course of the discussion of the appropriate rate of return to be employed it was concluded that whether the rate of return to assets or the rate of return to equity is employed, the relationship between rate of return and assets should be observed while holding constant interfirm differences in the variation of unlevered profit streams, leverage ratios and their interaction. Additional environmental variables which should be held constant are:

(a) the rate of growth of sales, (b) the Herfindahl index of the industry to which the firm is assigned, (c) a measure of diversification.

The rate of growth of sales takes account of any differences in profit rates which are due to differences in the rate of growth rather than the size of the firms involved. If, for example, firms involved are assigned to either of two classes according to whether their sales are growing or de-

clining one expects that, given asset size, the profit rates of the firms in the former class will be greater. Within the class of growing firms, it will not necessarily be the case that those with the higher rate of growth are more profitable. For this reason the relationship between the rate of growth of sales and the profit rate may be neither continuous nor monotonically increasing.

The Herfindahl index will take account of any variation in profit rates which are due to market concentration rather than size. If, for example, larger firms also have monopoly power the omission of the Herfindahl index would lead to the attribution to firm size an effect which is due, in fact, to monopoly power.

Rhoades (1973) has argued that, other things being equal, a diversified firm will earn a higher rate of return than a nondiversified firm. Two reasons are given. The first is that the diversified firm can use the earnings from other lines of business to finance the type of predatory pricing which will deter entry into any one of its lines of business. The second is that, because published financial statements are consolidated, potential entrants observe only that the diversified firm as a whole has a relatively high rate of return. The line of business which generates this rate of return is not identified. Entrants do not know where to enter and relatively high rates of return can be sustained over time.

These arguments require some qualification. A predator must have the capacity to supply market demand at the

predatory price, since otherwise the intended victims need not meet the predatory price. They can continue to sell at least some of their output at prices above the predatory price. As Wenders (1971) and others have pointed out, it is the capacity to expand one's market share, to one hundred per cent if necessary, which makes the predatory threat credible. A relatively small producer, whether diversified or not, is simply without the capacity to be an effective predator. A relatively large producer is a credible predator and, as such, may be able to finance a price war from external, albeit informal, sources. Stigler (1967) has made this point. In this case diversification is neither necessary nor sufficient to sustain predatory behaviour. More generally one would expect diversification to make predation more effective only in concentrated industries - that is where existing firms have relatively large market shares. This implies that it will be diversification interacting with market concentration which will cause higher profit rates. These variables would therefore enter a regression model multiplicatively.

Consolidated reporting does deprive outsiders of information regarding the rate of return to each product line. Some have argued that product line information is not meaningful so that its absence imposes no costs on potential entrants. Granting that it is meaningful, it is still not clear how important it would be to a potential entrant. A potential entrant will likely be familiar with the relevant technology and demand conditions. Returns to entry may well be inferred from

past patterns of market prices and the entrant's own knowledge of the costs of production. In this case consolidated reporting is at most, a minor inconvenience. If disaggregated rate of return information is both meaningful and necessary, consolidated reporting merely gives insiders the rights to dispose of product line information so as to further their own interests. They may choose to remain "loyal" and not act on product line information. They may leave the firm and enter the profitable lines of business on their own. Finally, they may sell the information to others who then enter the profitable product lines. In the latter two cases the returns to the information monopoly accrue not to the firm but to the insiders. In this case the returns to diversified firms will not exceed those earned by similar non-diversified firms.

The preceding discussion implies that a test of the null hypothesis that absolute size per se has no effect on profit rates can be conducted by estimating the following equations:

$$\begin{aligned} (P/E)_i = & a_0 + a_1/A_i + a_2\sigma_i + a_3(D/E)_i + a_4[\sigma_i(D/E)_i] \\ & + a_5\dot{S}_i + a_6H_iV_i + e_i \end{aligned} \quad (10)$$

where P = annual after tax profits of the  $i^{th}$  firm

E = beginning of period stock holders' equity of the  $i^{th}$  firm

$A_i$  = total assets, net of depreciation at the beginning of the period, of the  $i^{th}$  firm.

$\sigma_i$  = standard error of the rate of return to equity over the period 1961-1974.

$D$  = long-term debt of the  $i^{\text{th}}$  firm at the beginning of the period.

$\dot{S}_i$  = rate of growth of sales of the  $i^{\text{th}}$  firm.

$H_i$  = Herfindahl index of the industry to which the  $i^{\text{th}}$  firm is assigned

$V_i$  = a summary measure of diversification<sup>1</sup>

Equation (10) has been specified without a time dimension. Assigning it a time dimension requires that some assumptions be made about the speed at which profit rates adjust to year-to-year changes in the independent variables. Hall and Weiss have pooled time-series and cross-section observations and estimated an equation which could be written, in part, as

$$(P/E)_{it} = a_0 + a_1/\ln A_{it} + \dots \quad (11)$$

Their specification carried with it the assumption that the entire effect of a change in the assets of the  $i^{\text{th}}$  firm is reflected in the profit rate of that firm during the period in which it occurs. Coefficient  $a_1$  thus represents the long-run or equilibrium effect of firm size on profit rates. If the time pattern of adjustment is other than instantaneous, the Hall and Weiss model is misspecified and their  $\hat{a}_1$  is not an unbiased estimate of the long-run effect of size on profit rates.

The consequences of this misspecification depend on the nature of the "true" adjustment mechanism. Consider the

"true" model

$$(P/E)_{it} = k_0 + k_1 A_{it} + k_2 A_{it-1} \quad (12)$$

First let  $k_1 = k_2 > 0$ . The long-run effect of an increase in size on the rate of return amounts to  $k_1 + k_2$  and takes two periods to manifest itself. The adjustment is spread evenly over these two periods. Employing the Hall and Weiss assumption one would estimate

$$(P/E)_{it} = k_0 + k_1 A_{it} \quad (13)$$

and it can be shown that

$$E(\hat{k}_1) = k_1 + k_2 \frac{\text{cov}(A_{it}, A_{it-1})}{\text{var}(A_{it})} \quad (14)$$

Under the above assumptions  $\hat{k}_1$  is an over-estimate of  $k_1$ . It approximates the long-run effect,  $k_1 + k_2$ , only if current and lagged assets are perfectly correlated and have the same variance. To the extent that the assets of the  $i^{\text{th}}$  firm differ from year to year  $\hat{k}_1$  will understate the total effect of size on rate of return.

Assume now that the gains from an increase in size in year  $t$  are somehow competed away in year  $t+1$  so that  $k_2 = -k_1 < 0$ . Then  $E(\hat{k}_1)$  will, under Hall and Weiss assumptions and imperfect correlation of  $A_{it}$  and  $A_{it-1}$ , overstate the total effect (which is zero) of size on rate of return.

If annual observations are to be used, estimates of (10) must allow, initially at least, for adjustment lags. In order to avoid the problem of adjustment lags some investiga-

tors average the observations on each firm over a number of years. If averages are taken over a complete business cycle the dependent variable is purged of cyclical variations. Interfirm differences in the secular or long term trend of profit rates are then assumed to be captured by the rate of growth of sales.

The estimation of (10) undertaken in this study employs both alternatives. First, annual observations are employed with alternative lag distributions on the independent variables. Second, all variables are averaged over three years. When annual observations are employed separate cross-sections can be estimated for each year or, assuming as do Hall and Weiss, the regression coefficients are stable over time, annual cross-sections can be pooled and a single set of coefficients estimated. Again both options are pursued here. This study differs, however, from that of Hall and Weiss in that no pooling of cross-sections is undertaken until the intertemporal stability of the regression coefficients, both slope and intercept, has been established.

Finally, Hall and Weiss assume that the error term ( $e_i$  in equation (10)) is a decreasing function of firm size so that

$$Ee_i^2 = \sigma^2/A_i \quad (15)$$

For least squares estimates of  $\sigma^2$  to be unbiased and for tests of hypotheses to be accurate the variance of the error term  $e_i$  must be constant. To obtain an error term with the

requisite constant variance Hall and Weiss multiply all variables by  $(A_i)^{\frac{1}{2}}$ . In this study this type of weighting scheme is employed only after it is ascertained that the variance of the error term is not, in fact, constant. At this point the weighting scheme which produces constant variance is employed. This does not necessarily imply multiplication of all variables by  $(A_i)^{\frac{1}{2}}$ .

Estimates of (10) obtained from a sample comprised of 113 public companies observed during each of the years 1971, 1972, and 1973 are reported in Tables IV and V. The companies are incorporated and have shares traded in Canada. The range of firm sizes included in the sample is reflected in their 1972 asset values which range from \$2.4 million to \$2078.3 million with a first quartile of \$26.3 million, a median of \$70.4 million and a third quartile of \$228.1 million. If the advantages of size are not manifest within this range they either do not exist or are irrelevant.

In the course of estimating (10) it was discovered that the a priori importance attached to adjustment lags was unwarranted. Equations specified with adjustment lags were not materially different in their implications from unlagged equations. For this reason in the estimates reported all independent variables which are "stock" variables are observed as at the beginning of the year in which the rate of return is measured. The values of assets, long-term debt and equity to be used to explain interfirm differences in profit rates during year  $t$  are taken from the year end balance sheet for

year  $t-1$ . The standard error of the rate of return and the H-index are measured only once and can not, therefore, have a lag distribution. The rate of growth of sales is measured over a five year period ending in the year under investigation.

Goldfeld-Quandt tests revealed that the tendency for the variance of the residuals to decline as firm size increased was weak. In two cases weighting was required. For rate of return on equity regressions in 1971 and 1972 weights of  $(A)^{.15}$  and  $(A)^{.25}$  respectively were sufficient to eliminate heteroskedasticity. In all other cases the error terms of the unweighted regression was homoskedastic. The employment of weights such as these results in higher  $R^2$  and F values. These statistics should not, therefore, be used to compare regressions reported in Tables IV and V.

Tests for the homogeneity of the regression coefficients over time revealed that, in regressions employing the rate of return of equity as a dependent variable, the intercept coefficients differ from year to year while the slope coefficients do not. In regressions employing the rate of return on assets as a dependent variable neither the slope nor the intercept coefficients showed statistically significant year to year differences. Pooled regressions are therefore estimated with three intercepts (one each for 1971, 1972 and 1973) and one set of slope coefficients,  $a_1 \dots a_6$ , when the dependent variable is the rate of return on equity and with one intercept and one set of slope coefficients,  $a_0 \dots a_6$ , when the dependent variable is the rate of return on assets.

The principal reason for the estimation of (10) was to provide information on the relationship between firm size and rate of return. A number of alternative functional relationships (see 9(a) ... 9(d)) were estimated although only that which employs the logarithm of assets is reported. The conclusion reached is as close to unequivocal as is possible in this type of work. It is that there is no relationship between firm size and rate of return. As can be seen in Tables IV and V the coefficient of assets,  $a_1$ , is significant and positive for only one year, 1973. It is insignificant for 1971 and 1972, for the three year average and for the 1971-1972-1973 pooled regressions.

If firm size is consistently irrelevant to the explanation of interfirm differences in rates of return, the rate of growth of sales is a consistently important variable. Its coefficient,  $a_5$ , is significant and positive in virtually all regressions. The rate of sales growth, as measured, includes both a long-run trend effect and a current capacity utilization effect. A more sophisticated treatment would separate these two.

A second variable the coefficient ( $a_2$ ) of which is generally significant and has the predicted positive sign is the standard error of the rate of return. It is significant for the 1973, three year average and three year pooled regressions when the dependent variable is the rate of return on equity. It is significant at the 5% level for 1973 and the three year average regressions and at the 10% level for the

pooled regression where the dependent variable is the rate of return on assets. The general inference that can be drawn here is that firms which are riskier in the sense that they have experienced more year-to-year variability in their rates of return, earn--presumably because they are required by the market to do so--higher rates of return.

The standard error measured here is that of the after tax rate of return on equity over the period 1961-1973. Unlike the standard error of earnings on assets before interest and taxes (EBIT) it is very much a summary measure of the risk to be borne by the owners of the firm. It measures both business risk (from demand variability and operating leverage) and financial risk (from financial leverage). It may be for this reason that the coefficient of the debt:equity ratio is generally insignificant. The increase in the rate of return required by equity holders when leverage is increased is due to the increased variability of the rate of return resulting from that leverage, and this variability is reflected in the standard error of the rate of return. The standard error reflects both business and financial risk and, in this case, renders the leverage (debt:equity) ratio unnecessary. The regressions in which the leverage ratio is significant all have profits plus interest as the numerator of the dependent variable. This is consistent with the findings reported above. If the profit available to shareholders per dollar of equity does not change with the leverage ratio then profit available to shareholders plus interest paid per dollar

of equity must increase with the leverage ratio.

The coefficient of the interaction of the standard error and the leverage ratio,  $a_4$ , is often significant but always the wrong sign. Part of the problem may again be in the definition of the standard error. Its effect includes that of the leverage ratio. The interaction of the two may be revealing a non-linearity in the effect of the standard error on the rate of return. Although it is less than plausible intuitively, the rate of return required by the market may increase with the standard error but by decreasing amounts. A resolution of this question could be achieved by replacing the current standard error with the standard error of earnings before interest and taxes in the interaction variable.

The coefficient of the interaction of the measure of diversification and the Herfindahl index,  $a_6$ , is often significant and always the wrong sign. It implies that the more diversified the firm and the more concentrated is its "home" industry, the lower is its rate of return. Since the meaningfulness of the diversification measure employed and of the assignment of "home" H-index to these firms is in doubt, the regression is, in effect, testing both a theoretical hypothesis and an hypothesis about the quality of the data simultaneously. It is not clear, then, which, if either, of these should be rejected on the basis of the results in Tables IV and V.

In summary, differences in the rates of return reported by this sample of relatively large public companies are

TABLE IV  
Estimates of Equation (10)

<u>Year</u>	$a_0$	$a_1^*$	$a_2$	Coefficients			$a_6$	N	F**	WT.
				$a_3$	$a_4$	$a_5$				
1971	.129	-.012	.323	-.006	-.938	.018	-.006	113	4.7(6,106)	none
	(3.84)	(1.91)	(1.43)	(.12)	(1.96)	(1.79)	(.48)			
1971	.115	-.006	.187	-.035	-.789	.019	-.007	113	5.0(6,106)	$(A_i)^{.15}$
	(3.22)	(.96)	(.80)	(.64)	(1.48)	(1.96)	(.64)			
1972	.058	-.001	.314	.047	-.970	.041	-.029	113	3.8(6,106)	none
	(1.46)	(.02)	(1.46)	(.74)	(1.78)	(2.93)	(2.40)			
1972	.067	.003	.167	.015	-.650	.033	-.023	113	9.7(6,106)	$(A_i)^{.25}$
	(1.67)	(.47)	(.79)	(.27)	(1.32)	(2.68)	(2.40)			
1973	-.021	.016	.734	.058	-1.17	.055	-.041	112	4.6(6,105)	none
	(.44)	(2.10)	(2.41)	(.75)	(1.54)	(4.13)	(2.91)			
pool	***	.003	.355	.026	-.822	.039	-.028	338	12.8(8,329)	none
		(.54)	(2.59)	(.72)	(2.52)	(5.81)	(3.73)			
3 year average	.052	.001	.569	.089	-1.31	.034	-.026	111	3.2(6,104)	none
	(1.56)	(.17)	(2.53)	(1.61)	(2.30)	(2.88)	(2.58)			

t statistics in brackets

\* log Assets is used in all regressions reported

\*\* F Statistic is biased upwards when weights are used

\*\*\* Three intercepts are estimated one for each of 1971,72,73.

TABLE V

Estimates of Equation (10)  
Alternative Dependent Variables

Dependent Variable	a <sub>0</sub>	a <sub>1</sub>	a <sub>2</sub>	a <sub>3</sub>	a <sub>4</sub>	a <sub>5</sub>	a <sub>6</sub>	N	F	WT.
(After tax profit + interest) ÷ equity (pooled)	***	.002 (.44)	.328 (2.41)	.091 (2.48)	-.818 (2.51)	.040 (6.04)	-.028 (3.78)	338	12.9	none
(After tax profit + interest) ÷ net assets, 1971	.063 (4.11)	-.002 (.78)	.087 (.84)	-.020 (.83)	-.319 (1.46)	.012 (2.62)	-.004 (.77)	113	5.4	none
(After tax profit + interest) ÷ net assets, 1972	.039 (1.93)	.002 (.73)	.108 (.99)	.009 (.29)	-.292 (1.06)	.018 (2.49)	-.014 (2.24)	113	2.4	none
(After tax profit + interest) ÷ net assets, 1973	-.007 (0.28)	.012 (2.84)	.421 (2.65)	-.018 (.46)	-.517 (1.30)	.032 (4.57)	-.023 (3.15)	112	6.2	none
(After tax profit + interest) ÷ net assets (pooled)	.034 (2.29)	.001 (.50)	.107 (1.70)	.013 (2.10)	-.135 (2.58)	.023 (5.41)	-.017 (3.43)	338	7.5	none
(After tax profit + interest) ÷ net assets (3 year average)	.033 (1.89)	.004 (1.36)	.333 (2.87)	.012 (.43)	-.718 (2.43)	.017 (2.79)	-.013 (2.57)	111	4.8	none

largely random (unbiased  $R^2$  values are generally less than .25). The systematic differences can be traced to: (a) differences in rate of growth and rate of capacity utilization and (b) differences in risk of variability of the rate of return. In addition, the interaction of profit variability and leverage and concentration and diversification exert a statistically significant though theoretically implausible effect on the rate of return. Finally, and most importantly, there is no substantive evidence that within this asset size range (\$2.4 to \$2078.3 million), large firms earn higher rates of return than smaller firms.

If the time were available the results obtained could well be made more informative by calculating the long-run growth rate of sales and the rate of capacity utilization and using them in the regressions.

### 3.2.5 Firm Size and Rate of Return: Evidence From Grouped Data

The last section reported the results of an investigation of the relationship between firm size and rate of return using corporate entity level data. In this section the same task is undertaken using data which are grouped into asset size classes. Since there are only seven size classes there are relatively few observations upon which to base estimates. Models estimated using size-class data must, therefore, be

very simple. It is not possible, for example, to standardize for inter-size-class differences in risk or the rate of growth of sales as was the case in the previous section. What will be observed here is the name firm size-rate of return relationship rather than the ceteris paribus relationship observed in the previous section.

The data published in Corporation Financial Statistics, 1971 are broken down into seven asset size classes which are: (i) less than \$250 thousand; (ii) between \$250 thousand and \$1 million; (iii) between \$1 million and \$5 million; (iv) between \$5 million and \$10 million; (v) between \$10 million and \$25 million; (vi) between \$25 million and \$100 million; (vii) more than \$100 million. Observed over two years, 1970 and 1971 they provide a set of 14 size-class-year observations for each of 16 industry groupings of the nonfinancial companies incorporated in Canada.

The alternative functional relationships between firm size and rate of return were discussed in the last section. If the effect of firm size on rate of return is allowed to differ across industry groupings, one of the alternative functional relationships could be estimated as

$$(\pi/E)_{it} = a_{01}YD_i + a_{02}(1-YD_i) + a_1 \ln A_{it} + v_{it} \quad (1)$$

where  $(\pi/E)_{it}$  = the ratio of after tax profits to stockholders' equity for the  $i^{\text{th}}$  size class during year  $t$ .

$A_{it}$  = average assets (net of depreciation) of firms in the  $i^{\text{th}}$  size class as at the end of year  $t$ .

$YD_i$  = one if the observation on the  $i^{th}$  size class is taken in 1970, zero otherwise.

$v_{it}$  = a random error term.

In a model such as (1) the intercept is allowed to vary from year to year while the marginal effect of size on the rate of return,  $a_1$ , is constrained to constancy over time. If the marginal effect of size on the rate of return is, in addition, constrained to constancy across all industry groups, the model would be written as

$$\begin{aligned}
 (\pi/E)_{it} = & a_{01j} YD_i \sum_{j=1}^{16} ID_j + a_{02j} (1-YD_i) \sum_{j=1}^{16} ID_j \\
 & + a_1 \ln A_{it} + v_{it}
 \end{aligned} \tag{2}$$

where  $ID_j$  = one if the  $i^{th}$  observation falls in the  $j^{th}$  industry grouping, zero otherwise.

In the case of model (2) a different intercept is estimated for each industry for each year. It is also prudent to estimate both these models employing observations from the largest six size classes only. The smallest size class is more likely to contain both firms for which profits may be taken as executive compensation and vice versa and corporate entities which are inactive and/or on their way to extinction. Any inferences drawn from estimates of all seven size classes must be consistent with those drawn from estimates employing the largest six size classes if one is to have any confidence in these results.

Estimation of models such as (1) and (2) using grouped data poses a unique set of statistical problems. In particular Johnston (1972) has demonstrated that if, in the case of the dependent variable, the observation taken on each group is an average of the observations taken on the members of the group, the variance of the error term of the population regression model varies inversely with the number of observations in the group. Specifically, the error variance for the  $i^{\text{th}}$  group ( $i = 1 \dots 7$ ) is

$$\sigma_i^2 = \frac{\sigma^2}{N_i} \quad (3)$$

where  $\sigma^2$  = a positive constant

$N_i$  = the number of firms in the  $i^{\text{th}}$  group.

Intuitively this proposition is quite simple. The observations used to estimate (1) and (2) are averages of the relevant variables taken over all firms in a given size class. The larger is the number of firms in a given size class the greater is the number of observations over which this average is taken. The greater the number of observations used to compute an average the less variable it will be over repeated sampling. Observations on the dependent variable taken on the size classes with the largest number of members will be less variable over repeated sampling. This violates the assumptions of the classical linear regression model which require, among other things, that each observation on the dependent variable have the same variance over repeated sampling.

Under some circumstances this problem is easily corrected. In the case of (3) above the multiplication of each observation by  $(N_i)^{.5}$  will result in a population regression model the error term of which has a constant variance equal to  $\sigma^2$ . There are two complications which render this simple solution inapplicable. First, the observations on the dependent variable are weighted rather than simple averages. That is

$$(\pi/E)_i = \frac{\sum_{\ell=1}^{N_i} \pi_{\ell}}{\sum_{\ell=1}^{N_i} E_{\ell}} \quad (4)$$

$$= \frac{\sum_{\ell=1}^{N_i} [(\pi_{\ell}/E_{\ell}) (E_{\ell}/\sum_{\ell=1}^{N_i} E_{\ell})]}{\sum_{\ell=1}^{N_i} 1} \quad (5)$$

so that  $\sigma_i^2 = \sigma^2 \left[ \sum_{\ell=1}^{N_i} (E_{\ell}/\sum_{\ell=1}^{N_i} E_{\ell})^2 \right]$  (6)

which collapses to  $\sigma^2/N_i$  only if each of the  $N$  firms in the  $i^{\text{th}}$  size class have an equal share of the size class equity.

Otherwise

$$\sigma_i^2 = \sigma^2 \left[ \sum_{\ell=1}^{N_i} (E_{\ell}/\sum_{\ell=1}^{N_i} E_{\ell})^2 - 1/N_i + 1/N_i \right] \quad (7)$$

and  $\sigma_i^2$  falls as the number of firms in the  $i^{\text{th}}$  size class increases and rises as the inequality of the size of the firms in the  $i^{\text{th}}$  size class increases. There is no way, short of having access to the underlying data, of knowing the size of the first term in the brackets. As a consequence there is no way of knowing the nature of the heteroskedasticity which remains after all observations are multiplied by  $(N_i)^{.5}$ . One must simply assume that it is not large.

A second problem is that the variation in the rate of return to each firm in each size class may not be the same over repeated sampling. Comanor and Wilson (1969) have argued that this is the case. Citing the findings of Hall and Weiss (see Section 3.2.4) as justification, they assume that

$$\sigma_i^2 = \sigma^2 / \left( \sum_{\ell=1}^{N_i} A_{\ell} / N_i \right) N_i \quad (8)$$

$$\text{so that } \sigma_i^2 = \sigma^2 / \sum_{\ell=1}^{N_i} A_{\ell} = \sigma^2 / A_i \quad (9)$$

This combination of the usual assumption about grouped data with the Hall and Weiss assumption about the variance of rates of return to firms results in a correction which consists of multiplying each observation by  $(A_i)^{.5}$ .

As was demonstrated using equations (4) - (7) there is no reason to believe that a relationship such as (3) is a characteristic of the population regression model and therefore no reason to believe that multiplication by  $(N_i)^{.5}$  is the appropriate correction. It has already been demonstrated that the evidence does not support the Hall and Weiss assumption that

$$\sigma_{\ell}^2 = \sigma^2 / A_{\ell} \quad (10)$$

and that there is, therefore, no reason to believe that multiplying by  $(A_i)^{.5}$  is the appropriate correction. Given this uncertainty regarding the nature of the heteroskedasticity in the population regression model, an empirical approach to its correction would appear to be appropriate. The latter amounts to a search for the weighting scheme which eliminates hetero-

skedasticity in the estimated regression equations. Given the fewness of observations involved the empirical approach is itself unlikely to be conclusive.

As a compromise both the number of firms in each size class and size class assets are employed as weights in the form suggested by equation (3) and (10) respectively. The efficacy of both weighting schemes in eliminating heteroskedasticity is tested empirically. Weights which fail to do this are adjusted accordingly. Conclusions are drawn only when results obtained under both weighting schemes are the same.

Estimates of model (2) are reported in Table VI. Since coefficient  $a_1$  in model (2) summarizes the effect of firm size on rate of return over all industries and time periods, it is the estimates of  $a_1$  upon which attention is focussed. Estimates of model (1) for each of sixteen industry groupings are not reported but are available from the authors.

The results reported in Table VI indicate that insofar as the "all industry" sample is concerned, there is a positive relationship between firm size and rate of return. This is true of samples both including and excluding the smallest size class. The relationship is clearly non-linear with successive increments in firm size yielding successively smaller increases in rates of return. The relationship holds regardless of weighting scheme employed.

The relationship observed in the "all industry" sample appears to be due largely to a relationship which exists

in the non-manufacturing industries. There is no size-rate of return relationship in the manufacturing sector when asset weights are employed. When the number of firms in the size class are employed as a weight a positive size-rate of return relationship can still be inferred. One makes this inference with considerably less confidence than was the case with the "all industry" sample.

Baumol's hypothesis was that large firms could employ their large blocks of capital to pursue any attractive investment opportunity. If a positive size-rate of return relationship is to be observed, it should be observed everywhere. If it is eliminated by the assembly of blocks of capital to take on "big" projects it will be eliminated everywhere. There is no reason to observe a size-rate of return relationship due strictly to the capital assembly advantages of the large firm in one industry and not in another. Thus the ambiguity of the size-rate of return relationship in the manufacturing sector leads one to ask whether any of the positive size-rate of return relationships observed should be interpreted as support for Baumol's hypothesis or as a manifestation of the incomplete specification of the model. This is especially true in the light of the absence of any size-rate of return relationship in the fully specified model reported in Section 3.2.4. The theoretical questions raised in Section 3.2.2 can only amplify these doubts.

Some of the data employed in the above analysis is also reported in the Corporations and Labour Union Returns

Act Report for 1972, Part I. The CALURA report contains financial statement information for all firms with assets in excess of \$5 million. This information is grouped into three size classes. Although some analysis of these data was undertaken it was decided that it would serve no useful purpose to report it in detail. There are two reasons for this. First the CALURA data constitute a subset of the corporate financial statistics data (all corporate entities with assets in excess of \$5 million) and, as such, provide no new information. Second the size classes into which the CALURA data are grouped are larger. Intra-class variation in rates of return is therefore higher relative to inter-class variation. These data may reveal no size-rate of return relationship simply because the relationship exists largely within a given size class.

Analysis of the CALURA data revealed no evidence whatever of a relationship between firm size and rate of return. While it is not surprising, this finding does nothing to dispel the doubts raised previously regarding the validity of the positive size-rate of return relationship inferred from the corporate financial statistics data.

TABLE VI

Model (2)\*

Sample	d.f.	Size Variable (Weight)		
		$A_{ijt}$	$\ln A_{ijt}$	$1/A_{ijt}$
1. Pooled, All Industries, All Size Classes	179	$-.3(10^{-4})(A) \cdot 10$ (0.45)	$.008(A) \cdot 10$ (3.22)	$-.005(A) \cdot 10$ (3.66)
2. Pooled, Manufacturing Only All Size Classes	107	$-.6(10^{-6})(A) \cdot 35$ (0.02)	$.001(A) \cdot 35$ (0.44)	$-.003(A) \cdot 35$ (1.79)
3. Pooled, All Industries, Smallest Size Class Omitted	149	$-.4(10^{-4})(A) \cdot 25$ (0.66)	$.007(A) \cdot 25$ (2.17)	$-.025(A) \cdot 25$ (3.68)
4. Pooled, Manufacturing Only, Smallest Size Class Omitted	89	$-.1(10^{-4})(A) \cdot 25$ (0.30)	$-.001(A) \cdot 25$ (0.31)	$-.008(A) \cdot 25$ (1.05)
5. Pooled, All Industries, All Size Classes	179	$-.1(10^{-4})(N) \cdot 10$ (0.26)	$.010(N) \cdot 10$ (3.85)	$-.005(N) \cdot 10$ (3.85)
6. Pooled, Manufacturing Only All Size Classes	107	$.1(10^{-4})(N) \cdot 10$ (0.19)	$.004(N) \cdot 10$ (1.70)	$-.005(N) \cdot 10$ (3.00)
7. Pooled, All Industries, Smallest Size Class Omitted	149	$.5(10^{-5})(N) \cdot 30$ (0.07)	$.013(N) \cdot 30$ (4.08)	$-.026(N) \cdot 30$ (4.63)
8. Pooled Manufacturing Only Smallest Size Class Omitted	89	$-.9(10^{-5})(N) \cdot 10$ (0.16)	$.002(N) \cdot 10$ (0.81)	$-.013(N) \cdot 10$ (2.31)

\* t-statistics reported in brackets under coefficient estimates. All weights are for the  $i^{\text{th}}$  size class in the  $j^{\text{th}}$  industry for the  $t^{\text{th}}$  year.

### 3.2.6 Size and the Composition of the Financial Statement

In Section 3.3.2 it was argued that, if it is the case that large firms can raise capital on financial markets at a lower cost than is incurred by small firms or if, in the extreme case, small firms are somehow unable to raise capital on financial markets at all, one expects that

- (i) Large firms will have lower retained earnings: asset ratios than small firms;
- (ii) Large firms will have higher dividend payout ratios than small firms;
- (iii) Large firms will have higher leverage or debt: asset ratios than small firms.

The possible existence of a relationship between firm size and any of the above financial ratios was investigated using the grouped data found in the Corporation Financial Statistics, 1971. The latter allows a comparison of 1970 and 1971 financial ratios over seven size classes of non-financial corporations assigned to 16 industry groupings.

A model which allows the effect of size on a given financial ratio to differ across industries but not over time can be written, for any given industry grouping, as

$$Y_{it} = a_{01}YD_i + a_{02}(1-YD_i) + a_{11}\ln A_{it} + v_{it} \quad (1)$$

where  $Y_{it}$  = retained earnings:assets for the  $i^{th}$  size class at the end of year  $t$ ,

or  $Y_{it}$  = long-term debt:assets for the  $i^{th}$  size class at the end of year  $t$ ,

or  $Y_{it}$  = dividends:net worth for the  $i^{th}$  size class during year  $t$ .

$YD_i$  = a dummy variable equal to one for all observations on the  $i^{th}$  size class occurring in 1970, zero otherwise.

$A_{it}$  = average assets per firm in the  $i^{th}$  size class at the end of year  $t$ .

$v_{it}$  = a random error term.

If the marginal effect of a change in firm size is assumed to be the same in each industry grouping a model which would estimate this effect could be written as

$$Y_{ijt} = a_{01j} YD_i \sum_{j=1}^{16} ID_{ij} + a_{02j} (1 - YD_i) \sum_{j=1}^{16} ID_{ij} + a_1 \ln A_{it} + v_{it} \quad (2)$$

where  $ID_{ij}$  is a dummy variable equal to one if the  $i^{th}$  observation falls in the  $j^{th}$  industry group and zero otherwise.

The dependent variables employed differ slightly from those suggested above. The long-term debt:asset ratio is employed as a measure of leverage. It has the added virtue of reflecting directly the fraction of assets financed by long-term debt. The dividends:net worth ratio is employed as a payout ratio. It reflects the fraction of all the resources potentially available to the shareholders which are actually paid out. It has the merit of avoiding payout ratios which are negative (when losses are made) and over 100 per cent (when dividends exceed current profits).

Problems arising in the estimation of models such as (1) and (2) were discussed in Section 3.2.5. Homoskedastic residuals were obtained, in this case, by weighting each industry-size class-year observation by the number of companies in that particular cell. This is the weighting scheme which is appropriate if the variance of the error term in the population regression model follows the pattern suggested in expression (3), Section 3.2.5. This weight is then tested for its efficacy in eliminating heteroskedasticity. Weights which fail to do so are adjusted in the appropriate direction. All regressions reported in Tables VII, VIII, IX are thus ultimately weighted by  $(N_{ijt})^x$  where  $x$  is determined empirically.

Estimates of  $a_1$  in model (2) provide an average effect of firm size on each financial ratio taken over all industries, size classes and years and are reported in Tables VII, VIII, IX. Estimates of model (1) are not reported but are available from the authors.

Evidence that large firms tend to rely relatively more on the capital market than small firms is provided first, by a positive relationship between firm size and dividend payouts (see Table VII). This relationship can be observed only among the largest six size classes and implies that dividend payout ratios (expressed as a proportion of equity) increase with firm size at a decreasing rate. Second, large firms finance relatively more of their assets from long-term debt (see Table VIII). Leverage increases with firm size at a

decreasing rate.

The relationship between firm size and the retained earnings:asset ratio (Table IX supports neither position unequivocally. Equations (1) and (2) imply a negative size-retained earnings:asset ratio relationship. This is further evidence that large firms rely proportionately more on the capital market. Equations (3) and (4) imply a positive size-retained earnings:asset ratio relationship which, in turn, implies that large firms rely proportionately less on the capital market. Again the "all industry" and manufacturing samples contradict one another.

These results are confirmed by estimates of the relationship between each of these financial ratios and firm size obtained from a sample of 319 firms on the Financial Research Institute tape. Using observations taken in 1970 and 1971 and allowing intercepts to vary across major groups it was found that both debt:assets and dividends:equity ratios increase with firm size. Retained earnings:asset ratios do not change. Detailed results are available from the authors.

One may thus conclude that larger firms pay out a greater proportion of their net worth which implies that they must rely to a greater extent on some external source of finance, such as long-term debt. There is no solid evidence that large firms rely more heavily on the other source of external finance, equity flotation. There is, therefore, only weak evidence, from this source, of generalized economies of securities flotation. Some direct evidence on this issue is clearly required.

TABLE VII

## Model (2)

 $Y_{ijt}$  = Dividends:Equity

Sample	d.f.	$A_{ijt}$	Size Variable (Weight)		
			$\ln A_{ijt}$	$1/A_{ijt}$	
1. All Industries, All Size Classes	179	$-7(10^{-5})(N)^{-.35}$ (0.50)	$-.001(N)^{-.35}$ (1.08)	$.002(N)^{-.35}$ (1.19)	
2. All Industries, Smallest Size Class Omitted	149	$-.1(10^{-4})(N)^0$ (0.85)	$.001(N)^0$ (0.50)	$-.009(N)^0$ (3.05)	
3. Manufacturing Only, All Size Classes	107	$.2(10^{-4})(N)^{-.45}$ (0.76)	$-.001(N)^{-.45}$ (0.30)	$.002(N)^{-.45}$ (0.77)	
4. Manufacturing Only, Smallest Size Class Omitted	89	$.1(10^{-4})(N)^0$ (0.31)	$.001(N)^0$ (0.64)	$-.011(N)^0$ (2.33)	

t-statistics in brackets below estimates of  $a_1$ . All weights have subscripts  $ijt$ .

TABLE VIII

## Model (2)

 $Y_{ijt}$  = Longterm Debt:Assets

	Sample	d.f.	$A_{ijt}$	Size Variable (Weight)		
				$\ln A_{ijt}$	$1/A_{ijt}$	
1.	All Industries, All Size Classes	179	$.4(10^{-3})(N)^{.15}$ (11.67)	$.011(N)^{.15}$ (5.95)	$-.002(N)^{.15}$ (2.29)	
2.	All Industries, Smallest Size Class Omitted	149	$.4(10^{-3})(N)^{.25}$ (11.84)	$.016(N)^{.25}$ (6.71)	$-.013(N)^{.30}$ (2.81)	
3.	Manufacturing Only, All Size Classes	107	$.2(10^{-3})(N)^0$ (4.27)	$.005(N)^0$ (2.36)	$-.001(N)^0$ (0.21)	
4.	Manufacturing Only, Smallest Size Classes Omitted	89	$.2(10^{-3})(N)^{.25}$ (3.76)	$.005(N)^{.25}$ (2.20)	$-.3(10^{-3})N^{.25}$ (0.34)	

t-statistics in brackets below  $a_1$  estimates.

TABLE IX

## Model (2)

 $y_{ijt}$  = Retained Earnings:Assets

Sample	d.f.	$A_{ijt}$	Size Variable (Weight)		
			$\ln A_{ijt}$	$1/A_{ijt}$	
1. All Industries, All Size Classes*	167	$-.1(10^{-3})(N)^0$ (2.90)	$.002(N)^{.05}$ (0.79)	$-.003(N)^{.05}$ (2.81)	
2. All Industries, Smallest Size Class Omitted	139	$-.1(10^{-3})(N)^{.05}$ (3.33)	$-.005(N)^{.05}$ (1.91)	$.008(N)^{.05}$ (1.06)	
3. Manufacturing Only, All Size Classes	107	$.2(10^{-3})(N)^{.05}$ (2.70)	$.012(N)^{.05}$ (4.98)	$-.007(N)^{.05}$ (5.62)	
4. Manufacturing Only, Smallest Size Class Omitted	89	$.1(10^{-3})(N)^{.10}$ (1.96)	$.006(N)^{.10}$ (2.12)	$-.021(N)^{.10}$ (2.81)	

t-statistics in brackets below  $a_1$  estimates.

### 3.3 FIRM SIZE AND EFFICIENCY IN THE DISPOSITION OF CAPITAL

#### 3.3.1 Introduction

It has been argued that, not only does the large and/or multi-market firm assemble capital at a lower cost than that incurred by smaller firms, it also reallocates capital from areas of declining economic activity to those of expanding economic activity at lower cost than would be incurred using the capital market. In his assessment of the economies of scale in financial activities which might be experienced by the conglomerate enterprise Steiner (1975) concludes

If capital economies play a decisive role it is in the increased ability to channel internally generated and undistributed profits into more profitable endeavors. Here is an important complementary (sic) with the economies available via efficient management. Capital budgeting is characteristically a major managerial responsibility; if it also an art (or science) in which it is possible to perform exceptionally well, access to a large cash flow and a wide variety of investment opportunities can make exceptionally profitable management possible. The conglomerate acquisition can increase both cash flows and investment opportunities. (p.65).

Similar arguments have been made by participants in the recent Canadian debate on the merits of large and/or multi-market firms. In its submission to the Royal Commission on Corporate Concentration, the management of Genstar Limited (1975) argued that, in a "well managed diversified corporation"

the initiative for investment lies with operating managers of separate businesses, but investment decisions are made centrally. The objective is to achieve at any one time a balance of businesses, each in a different stage of its net cash flow cycle. To ensure a long-term high net cash flow over the whole corporation, the currently high net cash flow positions must now provide the investment funds for those businesses where net cash flow is presently zero or negative but promises to be positive in the future if well managed and aggressively invested in. This process of recycling earnings and cash flow balancing (cross-subsidization) is the key to the well managed diversified corporation. (p.5).

It was further asserted that Genstar provided an example of a "well managed diversified corporation",

Genstar management moves internal cash flows from slower growth businesses to areas of higher growth and promising investment prospects .... Genstar has been selective in its re-investment allocation and has used the earnings of some businesses to finance others. (p.20).

Implicit here is the argument that the owners of the corporation and hence the economy as a whole gain from allowing management to reinvest past profits on their behalf. This must be true if it is assumed that managers always act in the interest of the owners. If, however, managers act in their own interest, their retention and reinvestment of past profits can be a source of inefficiency. Mueller (1969) has observed that

... as the firm's internal investment opportunities decline, it will be in the stockholders' best interests for the firm to begin to repay some of the profit and depreciation flow to the [stockholders] so that it can be reinvested elsewhere. (p.646).

However,

The management intent on maximizing growth will tend to ignore, or at least heavily discount, investment opportunities outside the firm since these will not contribute to the internal expansion of the firm. (p.647).

Thus the mature firm which is run by growth-oriented managers will undertake more internal investment than a stockholder welfare maximizing firm, pay less in dividends, and have a lower rate of return on the marginal investment project. (p.647).

The multi-market firm may thus be a manifestation of the expansionist tendencies of corporate bureaucracies rather than a low cost alternative to the capital market. If this is the case and managers are accepting rates of return on projects which can be internalized which are lower by more than the differential transactions costs involved in using the capital market than the rates of return the owners could earn elsewhere, there is an economic loss which is borne by the owners.

One method of inferring whether earnings retentions are in the interest of the owners or of the managers is to estimate the rate of return to new assets financed by retentions as opposed to those financed by equity or debt issues. If it is assumed that the rate of return on equity represents the opportunity cost of the owners' funds, and the estimated rate of return to retained earnings falls below the estimated return to equity by more than the sum of the differential costs of using the capital market and the value of any tax

advantage of capital gains over dividends, it can be inferred that corporate retention policies have reduced the wealth of their owners. To be more specific, if

$r_1$  = marginal rate of return to retained earnings

$r_2$  = marginal rate of return to equity

T = tax advantage, at the margin, of capital gains over dividends

c = differential cost, at the margin, of external over internal reallocation of funds

and

$$(r_2 - r_1) > T + c$$

there is a reduction in the owners' wealth which can be attributed to both corporate retention policies and the tax system. If

$$c < (r_2 - r_1) < T + c$$

there is a wealth reduction which is attributable to the corporate tax system alone.

The estimation and comparison of the rates of return to assets financed by each of retentions, new equity and new debt was first attempted by Baumol et al. (1970) who observed that

The individual purchaser of corporate stocks has long been told that ploughback works to his advantage particularly if he is in a high tax bracket, because it transforms his earnings into capital gains. But if it is true that ploughback makes no noticeable contribution to the company earnings this conclusion is thrown into question. The issue is also obviously important for society;

for if retained earnings have a negligible influence on future earnings, the efficiency of the process of capital formation becomes questionable. It might even be taken to suggest that management often retains earnings when it lacks profitable investment opportunities. (p.345).

Sections 3.3.2 and 3.3.3 are taken up with the specification and estimation of a model which will indicate the general efficiency with which retained earnings are reinvested. If it is found that the rate of return to retained earnings is well below the stockholders' opportunity cost, that is,  $(r_2 - r_1)$  is greater than  $T+c$ , both the efficiency of the internal capital market and the real advantages of large firms with large internal capital markets are cast into doubt.

If it is found that the rate of return to retained earnings approaches the stockholders' opportunity cost, that is  $(r_2 - r_1)$  is less than  $T+c$ , it can be inferred that, in general, retained earnings are being reinvested efficiently and that the internal capital market does not itself misallocate resources. The argument that large internal capital markets constitute a potential resource saving is then at least credible.

Since these findings apply only to the efficiency of the allocation of resources achieved, they can not be taken to imply that the internal capital market can achieve a given reinvestment task at a lower cost than can external markets. This will, of course, be claimed by the proponents of a given merger. Whether it is generally true and is thus

both a defence and a motive for attaining large size is not determined here.

### 3.3.2 The Productivity of Reinvested Earnings: A Model

Baumol et al postulated that the change in the earnings of a firm from one period to the next was a function of the value of the assets acquired during the first period. If, for example, new assets yield their expected rate of return the year after they are acquired, then

$$E_{it} - E_{it-1} = r_o (A_{it-1} - A_{it-2}) + u_{it}$$

or 
$$\Delta E_{it} = r_o \Delta A_{it-1} + u_{it} \quad (1)$$

where  $E_{it}$  = after tax profit of the  $i^{th}$  firm during year  $t$   
 $A_{it}$  = value of the assets of the  $i^{th}$  firm at the end of year  $t$

$r_o$  = expected value of the rate of return to capital

$u_{it}$  = the random component of the period to period change in earnings

Asset acquisitions may be financed by borrowing, issuing new equity or retaining past profits. It is therefore the case that

$$\Delta A_{it-1} \equiv P_{it-1} + N_{it-1} + D_{it-1} \quad (2)$$

where  $P_{it-1}$  = earnings retained by the  $i^{th}$  firm during period  $t-1$

$N_{it-1}$  = new equity issued during period  $t-1$

$D_{it-1}$  = new debt issued during the year  $t-1$

Substitution of (2) into (1) yields

$$\Delta E_{it} = r_0(P_{it-1} + N_{it-1} + D_{it-1}) + u_{it} \quad (3)$$

which implies that the rate of return on a new asset is independent of the manner in which its acquisition is financed. If, as Mueller has argued, management will accept a rate of return on retained earnings which is lower than that which the stockholders could earn elsewhere rather than pay these earnings out and lose the opportunity to participate in the activities associated with their reinvestment, one expects that new assets financed by earnings retentions will, on average, yield a lower rate of return than new assets financed by an equity issue. In this case (3) becomes

$$\Delta E_{it} = r_1 P_{it-1} + r_2 N_{it-1} + r_3 D_{it-1} + u_{it} \quad (4)$$

where  $r_2 > r_1$ .

Estimates of the values of  $r_1$ --- $r_3$  could be obtained from (4) for a cross-section of firms ( $i=1$ --- $N$ ) at a given point in time ( $t=T$ ). Estimates of the value of  $r_1$ --- $r_3$  will be more precise, however, if they are based on a series of year-to-year changes. Since the random components of annual earnings changes will tend to cancel (especially if the observation period spans an entire business cycle), changes in earnings averaged over a number of years will have a relative-

ly smaller random component and estimates of the values of  $r_1$ --- $r_3$  based on them will exhibit smaller sampling variance.

To obtain an average of T year-to-year changes in earnings upon which to base estimates of  $r_1$ --- $r_3$  one need only sum both sides of (4) over T periods obtaining

$$\begin{aligned} \sum_{t=1}^T \Delta E_{it} = & r_1 \sum_{t=1}^T P_{it-1} + r_2 \sum_{t=1}^T N_{it-1} + r_3 \sum_{t=1}^T D_{it-1} \\ & + v_{it} \end{aligned} \quad (5)$$

Equation (5) collapses to

$$\begin{aligned} E_{iT} - E_{i0} = & r_1 (P_{i0} + \dots + P_{iT-1}) + r_2 (N_{i0} + \dots + N_{iT-1}) \\ & + r_3 (D_{i0} + \dots + D_{iT-1}) + v_{it} \end{aligned} \quad (6)$$

Each of the variables in (6) is observable and parameters  $r_1$ --- $r_3$  can be estimated by conventional means.

Equation (1) has been specified to reflect a one period lag between the acquisition of an asset and the point at which it contributes to earnings. If the lag is longer equations (1)---(6) must be modified accordingly. If the lag were two years, for example, and the independent variables were to be measured over the same period (years 0 to T-1), the dependent variable becomes

$$\sum_{t+1}^T \Delta E_{it+1} = E_{iT+1} - E_{i1} \quad (7)$$

Model (6) can therefore be estimated for different numbers of year-to-year changes (different values of T), dif-

ferent points in the business cycle and different lags between the acquisition of an asset and its yielding a contribution to earnings.

Baumol et al argue that model (6) ignores some available information and, in so doing, produces estimates of  $r_1$ --- $r_3$  with higher sampling variances than could be achieved. They argue that the data needed to estimate (6) could also be used to estimate any one or all of

$$E_{i1} - E_{i0} = r_1 P_{i0} + r_2 N_{i0} + r_3 D_{i0} + e_i \quad (6a)$$

$$\begin{aligned} E_{i2} - E_{i0} &= r_1 (P_{i0} + P_{i1}) + r_2 (N_{i0} + N_{i1}) \\ &\vdots \qquad \qquad \qquad \vdots \qquad \qquad \qquad \vdots \\ &\qquad \qquad \qquad + r_3 (D_{i0} + D_{i1}) + e_i \end{aligned} \quad (6b)$$

$$\begin{aligned} E_{iT-1} - E_{i0} &= r_1 (P_{i0} + \dots + P_{iT-2}) + r_2 (N_{i0} + \dots + N_{iT-2}) \\ &\qquad \qquad \qquad + r_3 (D_{i0} + \dots + D_{iT-2}) + e_i \end{aligned} \quad (6c)$$

and that estimates based on an average of all the earnings changes given in (6)---(6c) can be obtained by summing both sides of (6)---(6c) to yield

$$\begin{aligned} \sum_{t=1}^T (T-t+1) \Delta E_{it} &= r_1 \sum_{t=0}^{T-1} (T-t) P_{it} + r_2 \sum_{t=0}^{T-1} (T-t) N_{it} \\ &\qquad \qquad \qquad + r_3 \sum_{t=0}^{T-1} (T-t) D_{it} + \epsilon_{it} \end{aligned} \quad (8)$$

and estimating the parameters of (8).

It should be emphasized that models (4), (6) and (8) are equally valid. Each successive model simply contains more information and as a result should be characterized by parameter estimates with a lower sampling variation. Models (4), (6) and (8) are complete except for their failure to standardize for interfirm differences in risk. Risk can be defined operationally as the standard deviation of the distribution of the rates of return earned by a firm over a period of years. Some of this risk can be diversified away by including shares in the firm in a larger portfolio of shares in firms with rates of return which are less than perfectly correlated with that of the former. The portion of the risk which can not be diversified away is called nondiversifiable risk. Since it is for the assumption of risks which can not be diversified away that asset holders must be compensated, one expects to observe a positive relationship between the rate of return earned by a firm and the nondiversifiable risk its owners incur. For the sake of comparability with earlier studies which employ total risk measures and to test the proposition that it is nondiversifiable rather than total risk which is relevant to the determination of the rate of return, both risk measures are employed in this study. This requires that (1) be rewritten as

$$\Delta E_{it} = r_o \Delta A_{it-1} + r_4^S \Delta A_{it-1} + u_{it} \quad (1a)$$

or as

$$\Delta E_{it} = r_o \Delta A_{it-1} + r_4^\beta \Delta A_{it-1} + u_{it} \quad (1b)$$

where  $S$  = total risk

= the standard deviation of the rate of return of the  $i^{\text{th}}$  firm over a  $k$  year period

and  $\beta$  = nondiversifiable risk

= the slope coefficient of a regression of the  $i^{\text{th}}$  firm's rate of return on an aggregate rate of return estimated over a  $k$  year period.

If one assumes that the level of risk exerts an effect on the rate of return which is independent of the type of financing employed, equation (8) can be rewritten as

$$\begin{aligned} \sum_{t=1}^T (T-t+1) \Delta E_{it} = & r_1 \sum_{t=0}^{T-1} (T-t) P_{it} + r_2 \sum_{t=0}^{T-1} (T-t) N_{it} \\ & + r_3 \sum_{t=0}^{T-1} (T-t) D_{it} + r_4 \sum_{t=0}^{T-1} (T-t) S \Delta A_{it} + \varepsilon_{it} \end{aligned} \quad (8a)$$

and (6) could be rewritten in a similar fashion.

If one were to assume that the effect of risk on the marginal rate of return to new assets depends on the type of financing employed, both (6) and (8) would have to be rewritten so as to include an interaction term between either  $S$  or  $\beta$  and each of  $P$ ,  $N$  and  $D$ .

There do not appear to be any grounds for the inclusion of the risk variable in a strictly additive form. This form would imply that riskier firms will have increases in earnings whether or not new assets are acquired. This is incorrect. The change in earnings will be a function of net asset acquisitions and changes in risk but not of the level of

risk. While Baumol et al appear to be aware of this problem (see n.10, p.350), all the results they report employ risk in a strictly additive form. Friend and Husic (1973) also confine themselves to the strictly additive form.

### 3.3.3 Estimation of the Rate of Return to Retained Earnings

Model (8a) is estimated using a sample of 205 companies taken from the Financial Research Institute tape. Base periods (years 0---T-1 in equation (8)) are taken as 1962-1966, 1963-1967 and 1964-1968. Lags of up to four years are employed. Estimates of (8a) for each successive base period are reported in Tables XI, XII, XIII respectively. Estimates of model (6a) are, for reasons given below, not reported but are available from the authors as are estimates obtained with shorter base periods lying within the same time period.

The major estimation problem centers around the necessity of correcting for heteroskedasticity (given the importance attached to hypothesis testing in the present context) and the desire of some investigators (see Friend and Husic (1973)) to correct for the so-called "size effect". With regard to the former it is assumed that the error term of the population regression model has a zero expectation, is homoskedastic time-wise but heteroskedastic cross-sectionally so that

$$E(\epsilon_{it})^2 = \sigma^2 A_i^\delta \quad (9)$$

Homoskedastic residuals can then be obtained by weighing all variables by  $A_i^{-(\delta/2)}$ , where the value of  $\delta$  is the one at which the null hypothesis of homoskedastic residuals can not be rejected using the Goldfeld-Quandt (1965) Test. If the appropriate value of  $\delta$  is two, heteroskedasticity can be eliminated by dividing all variables by  $A_i$ . The latter procedure was adopted by Friend and Husic who deflated all variables except risk by average base period assets (p.124). If the true value of  $\delta$  were one, however, the Friend and Husic procedure would result in an error term, the variance of which would follow the pattern

$$E(\epsilon_{it}/A_i)^2 = \sigma^2 A_i / (A_i)^2 = \sigma^2 / A_i \quad (10)$$

which is heteroskedastic in the "opposite direction".

With regard to the so-called size effect, it is true that size of a regression coefficient can be influenced by very large observations as can the arithmetic mean. It can also be influenced by very small observations. There is no reason to believe that size affects any of  $r_1$ --- $r_3$  estimates differently or that the removal of the linear influence of size by means of a transformation such as is employed by Friend and Husic results in  $r_1$ --- $r_3$  estimates which are "more correct". In this study, the "appropriate" correction for "the size effect" is taken to be that which eliminates heteroskedasticity. An intuitive rationale for this procedure was provided by Wonnacott and Wonnacott (1970) who argued

The underlying philosophy is simple enough. A greater error occurs in the [larger observations on the independent variable]; thus these observations give a less precise indication of where the true regression line lies. Therefore it is reasonable to pay less attention to these than to the more precise observations on the [smaller values of the independent variables]. Weighted least squared provides a means of fitting a line by deflating the influence of less precise observations (p.133).

To the extent that observations on the larger firms are "less reliable" their weight in the regression will be reduced. But it will be reduced only to this extent. Simple deflation by assets may well have the effect of making observations on smaller firms "less reliable".

If weighted estimates are to be obtained, all variables in the regression must be weighted. Otherwise, the weighting will change the specification of the model. For example, by applying a weight of  $(A_i)^{-1}$  to all variables except the risk variable, Friend and Husic changed their specification from one in which risk enters additively to one in which risk enters multiplicatively with the level of assets. As the discussion above has indicated, both these specifications are incorrect.

The variable definitions employed in this study are similar to those of Baumol et al. They are:

E = profit after tax + depreciation + interest payments  
P = retentions = after tax profit + depreciation -  
dividends.

N = new equity = change in the book value of common  
stock outstanding.

$D$  = new debt = change in the book value of long-term debt outstanding

$\Delta A$  = change in the book value of assets net of depreciation

$S$  = standard deviation of the ratio of after tax profit to shareholders equity over the period 1961-1974.

$\beta$  = slope coefficient of a regression of the  $i^{\text{th}}$  firm's rate of return on equity on the average annual rate of return earned by all industrial companies (see n.3) over the period 1961-1974.

The new equity variable,  $N$  is the change in the value of common stock outstanding as given on the balance sheet. It excludes changes in contributed surplus an account which may contain, among other items, part of the proceeds of new issues of common stock.

Unlike its predecessors this study employs measures of both total and the theoretically preferable nondiversifiable risk as independent variables. Results obtained with the former are reported in Tables X and XII while results obtained with the latter occupy Tables XI and XIII.

Weighted estimates of (8a) will not contain a constant term. Since this specification is consistent with the population regression model it does not constitute a problem from the standpoint of statistical inference. For any given sample, however, the regression residuals may not sum to zero. Under these circumstances the variance in the dependent variable can

not be decomposed into explained and unexplained components in the usual way (see Kmenta (1971) p.364). For this reason the F-ratios reported for these regressions and  $\bar{R}^2$  values calculated are based on the total and regression sum of squares about the origin rather than about their respective means.

Although it is not included in the population regression model, an unweighted constant term is included in some regressions. This is equivalent to including the irrelevant explanatory variable  $(\bar{A}_1)^{\delta/2}$  in the unweighted model and is indefensible on grounds other than its similarity with the specification of Friend and Husic. Because it is not orthogonal to the other independent variables it changes the parameter estimates obtained. It will also have the effect of decreasing the efficiency of these estimates.

In their efforts to draw general conclusions from these models, previous investigators have averaged the coefficients obtained for alternative base periods and response lags. This procedure appears ill-advised, not so much because the estimates averaged are not independent but because this average must be based on all possible base-period-response lag combinations. The procedure adopted here is to attempt to isolate the "superior" results and draw inferences from them. Following Theil (1965, pp.211-14), the regression with the lowest residual variation is defined to be "superior". Since the dependent variable takes on different values when response lags differ, the coefficient of variation of the regression (the

standard error of estimate divided by the mean value of the dependent variable) which provides a normalized summary measure of residual variation is employed for the purpose of isolating the "superior" result. Coefficients of variation are reported in Tables X and XI.

Scrutiny of Tables X and XI reveals that, regardless of the measure of risk employed, estimated of (8a) which assume a one period lag are, by the standard set out above, superior to estimates which assume longer lags. Estimates which employ an unweighted constant term are marginally superior in the first two base periods and inferior in the third. Estimates of (6a) (not reported) are always inferior to those of (8a). This is not unexpected since estimates of (6a) ignore available information and will, as a consequence, be inefficient relative to those of (8a).

Regardless of the adjustment lag assumed or base period considered, estimates of (8a) which employ the nondiversifiable risk measure,  $\beta$ , do not differ markedly from those employing the total risk measure,  $S$ . The coefficients of both variables are, on occasion, significantly greater than zero (see 1.30, 3.10 Table XII and 1.10 Table XIII) as is expected but are more often either insignificant or, in the case of  $\beta$ , significant and negative (see 2.30 and 3.20, Table XIII.) The expectation that, ceteris paribus, nondiversifiable risk would be more likely to explain interfirm differences in rates of return than would total risk has clearly not been confirmed. Insofar as the measure of risk is concerned, no set of equations

can be adjudged superior and the set chosen for hypothesis testing is a matter of indifference.

These conclusions lead to the selection of estimates of (8a) which employ either risk measure and assume a one year adjustment lag as the equations from which inferences regarding the difference in the rates of return to retentions and new equity will be drawn. In the case of both the first and second base periods estimates with these characteristics pose a problem in that those with the lowest coefficient of variation (albeit by a small margin) contain an unweighted constant and are thus inconsistent with the population regression model. To avoid any misleading inferences both the equation with the lowest coefficient of variation and the equation which has the lowest coefficient of variation and is consistent with the population regression model, are employed in hypothesis testing. These appear in both Tables XII and XIII as equations 1.10 and 1.11 for the 1962-66 base period, 2.10 and 2.11 for the 1963-67 base period and 3.10 for the 1963-68 base period.

Examination of these equations reveals that each of the null hypothesis that  $r_1 = 0$ , that  $r_2 = 0$  and that  $r_3 = 0$  can be rejected at the five per cent significance level in all cases and at the one per cent level in all but four cases. The marginal effect of risk on the rate of return,  $r_4$ , is significant and positive in one of five cases when S is used and in two of five cases when  $\beta$  is used.

Most important for present purposes is the test of the null hypothesis that  $r_1$ , the marginal rate of return to

retained earnings, does not differ from  $r_2$ , the marginal rate of return to equity. Values of the appropriate test statistic are reported in Table XIV. In no case can the null hypothesis be rejected if a 5% significance level and a two tail test are employed.

The conclusion to be drawn from an examination of the superior specification(s) for each base period is that observed differences in the marginal rates of return to equity and retentions can reasonably be attributed to sampling variation and are not a characteristic of the underlying population. New assets financed by retentions appear to be neither more nor less productive than those financed by new equity issues.

This conclusion stands in marked contrast to the one which would be reached if, following Baumol et al, the estimates of  $r_1$  and  $r_2$  were simply averaged and compared. Without exception the point estimates of the marginal rate of return to equity are numerically (as opposed to statistically) greater than those of the marginal return to retentions. In equations which assume two and three period response lags the numerical difference between the two becomes relatively large and is sometimes statistically significant. Thus, if all equations were assumed equally reliable and were assigned equal importance, it could be inferred, albeit with considerable equivocation, that there is some tendency for the marginal rate of return on equity to exceed that on retentions. If only the most reliable equation for each base period is consulted, the conclusion is that there is no such tendency and it is unequivocal.

To summarize, the evidence from a sample of 205 Canadian corporations examined over the period 1961-1970 is that any differences between the rate of return to retained earnings and the stockholders' opportunity cost are statistically insignificant. The allocation of resources achieved by the internal capital market is, on average, no less efficient than that which is achieved in external capital markets.

The results obtained here establish the possibility of an internal capital market defence for large or multi-market firms. They establish only the possibility of such a defence because there is as yet no evidence that the internal capital market achieves a given reinvestment task at a lower resource cost than do external capital markets. The assembly of evidence on the relative costs of internal and external capital markets is thus the logical next step to be taken by future researchers.

TABLE X

Coefficients of Variation and  $\bar{R}^2$  Values:  
 Regressions Employing Total Risk, S

<u>Equation No.*</u>	<u>Coefficient of Variation</u>	<u><math>\bar{R}^2</math>**</u>
1.10	0.79	.64
1.20	0.84	.61
1.30	1.23	.42
1.11	0.78	.65
2.10	0.83	.62
2.20	1.15	.47
2.30	1.46	.36
2.11	0.81	.63
2.21	1.14	.47
3.10	1.04	.54
3.20	1.43	.39
3.11	1.05	.54

\* Equations reported in Table XII.

\*\* Percentage of variation about the origin which is explained by regression, adjusted for degrees of freedom.

TABLE XI

Coefficients of Variation and  $\bar{R}^2$  Values  
 Regressions Employing Nondiversifiable Risk,  $\beta$

<u>Equation No.*</u>	<u>Coefficient of Variation</u>	<u><math>\bar{R}^2</math></u>
1.10	0.79	.64
1.20	0.85	.61
1.30	1.24	.40
1.11	0.77	.66
2.10	0.82	.62
2.20	1.13	.48
2.30	1.42	.40
2.11	0.81	.63
2.21	1.12	.49
3.10	1.06	.52
3.20	1.40	.41
3.11	1.06	.52

\* Equations reported in Table XIII

TABLE XII

Model (8a): With Total Risk

Equation No.	Base Period	Lag (Years)	const.	P	N	D	SAA	unweighted const.	wt.	F*(d.f.)
1.10	1962-66	1	.702 (3.06)	.095 (7.12)	.113 (3.00)	.083 (3.37)	.398 (1.93)	-	(A) <sup>-0.7</sup>	73.86(5,200)
1.20	1962-66	2	.729 (2.73)	.093 (5.99)	.185 (4.25)	.059 (2.07)	.592 (2.46)	-	(A) <sup>-0.7</sup>	66.13(5,200)
1.30	1962-66	3	1.08 (3.65)	.053 (2.30)	.202 (3.06)	.104 (2.52)	.597 (1.83)	-	(A) <sup>-0.8</sup>	30.27(5,2)
1.11	1962-66	1	-.019 (0.06)	.053 (2.69)	.113 (3.06)	.065 (2.63)	.291 (1.41)	.313 (2.93)	(A) <sup>-0.7</sup>	65.26(6,199)
2.10	1963-67	1	.547 (2.77)	.099 (7.01)	.143 (3.34)	.111 (4.77)	.029 (0.18)	-	(A) <sup>-0.8</sup>	66.59(5,200)
2.20	1963-67	2	.973 (3.76)	.058 (3.12)	.160 (2.85)	.155 (5.08)	-.004 (0.02)	-	(A) <sup>-0.8</sup>	36.46(5,200)
2.30	1963-67	3	.760 (3.26)	.063 (2.87)	.249 (3.81)	.111 (3.21)	-.111 (0.49)	-	(A) <sup>-0.9</sup>	24.57(5,200)
2.11	1963-67	1	.137 (0.55)	.051 (2.24)	.140 (3.33)	.089 (3.72)	-.019 (0.11)	.196 (2.66)	(A) <sup>-0.8</sup>	58.38(6,199)
2.21	1963-67	2	.536 (1.64)	.007 (0.23)	.157 (2.83)	.133 (4.16)	-.055 (0.25)	.209 (2.15)	(A) <sup>-0.8</sup>	31.72(6,199)
3.10	1964-68	1	.388 (1.65)	.056 (4.12)	.106 (2.51)	.082 (3.49)	.390 (2.37)	-	(A) <sup>-0.8</sup>	50.38(5,200)
3.20	1964-68	2	.245 (1.08)	.068 (4.00)	.189 (3.84)	.037 (3.07)	-.062 (0.33)	-	(A) <sup>-0.9</sup>	25.11(5,200)
3.11	1964-68	1	.423 (1.37)	.059 (2.44)	.106 (2.51)	.083 (3.37)	.393 (2.37)	-.015 (0.18)	(A) <sup>-0.8</sup>	41.92(6,199)

\* F-ratio based on second moments about the origin

TABLE XIII

Model (8a) : With Nondiversifiable Risk

Equation No.	Base Period	Lag (Years)	const.	P	N	D	βAA	unweighted const.	wt.	F*(d.f.)
1.10	1962-66	1	.802 (3.57)	.095 (7.35)	.124 (3.43)	.094 (4.24)	.012 (2.14)	-	$\bar{A}$ <sup>7</sup> ( $\bar{A}$ )	73.93(5,200)
1.20	1962-66	2	.873 (3.31)	.104 (6.81)	.209 (4.91)	.085 (3.26)	.009 (1.25)	-	$\bar{A}$ <sup>7</sup> ( $\bar{A}$ )	63.89(5,200)
1.30	1962-66	3	1.18 (4.05)	.078 (3.54)	.236 (3.66)	.143 (3.80)	-.004 (0.41)	-	$\bar{A}$ <sup>8</sup> ( $\bar{A}$ )	28.79(5,200)
1.11	1962-66	1	.009 (0.03)	.047 (2.37)	.119 (3.37)	.069 (3.02)	.012 (2.09)	.332 (3.18)	$\bar{A}$ <sup>7</sup> ( $\bar{A}$ )	66.08(6,199)
2.10	1963-67	1	.543 (2.80)	.108 (7.96)	.144 (3.41)	.120 (5.67)	-.006 (1.31)	-	$\bar{A}$ <sup>8</sup> ( $\bar{A}$ )	67.51(5,200)
2.20	1963-67	2	.947 (3.77)	.076 (4.34)	.161 (2.94)	.173 (6.31)	-.015 (2.50)	-	$\bar{A}$ <sup>8</sup> ( $\bar{A}$ )	38.87(5,200)
2.30	1963-67	3	.706 (3.12)	.084 (4.11)	.243 (3.84)	.129 (4.13)	-.020 (3.22)	-	$\bar{A}$ <sup>9</sup> ( $\bar{A}$ )	27.84(5,200)
2.11	1963-67	1	.130 (0.53)	.058 (2.53)	.140 (3.37)	.096 (4.24)	-.006 (1.28)	.193 (2.65)	$\bar{A}$ <sup>8</sup> ( $\bar{A}$ )	59.12(6,199)
2.21	1963-67	2	.516 (1.60)	.025 (0.82)	.157 (2.89)	.148 (5.00)	-.014 (2.48)	.201 (2.12)	$\bar{A}$ <sup>8</sup> ( $\bar{A}$ )	33.70(6,199)
3.10	1964-68	1	.518 (2.23)	.070 (5.26)	.125 (2.98)	.120 (5.83)	-.001 (0.33)	-	$\bar{A}$ <sup>8</sup> ( $\bar{A}$ )	46.38(5,200)
3.20	1964-68	2	.272 (1.25)	.080 (4.99)	.180 (3.82)	.112 (4.67)	-.015 (3.02)	-	$\bar{A}$ <sup>9</sup> ( $\bar{A}$ )	29.11(5,200)
3.21	1964-68	1	.493 (1.59)	.068 (2.72)	.124 (2.95)	.119 (5.26)	-.001 (0.33)	.010 (0.12)	$\bar{A}$ <sup>8</sup> ( $\bar{A}$ )	38.46(6,199)

TABLE XIV

Values of the Test Statistic

$$t = (r_1 - r_2) / S(r_1 - r_2)^*$$

Table No.	Equation No.	t	degree of freedom	Conclusion **
III	1.10	-.44	200	Do Not Reject Null
III	1.11	-1.39	199	"
III	2.10	-.51	200	"
III	2.11	-1.78	199	"
III	3.10	-.81	200	"
IV	1.10	-.70	200	"
IV	1.11	-.17	199	"
IV	2.10	-.75	200	"
IV	2.11	-1.64	199	"
IV	3.10	-1.17	200	"

\*  $S(r_1 - r_2)$  is the standard error of the difference of two regression coefficients

\*\* Test of the null hypothesis that  $t = 0$  assuming a five per cent significance level and a two tail test.

### 3.3.4 The Importance of the Internal Capital Market

The previous sections have examined the efficiency with which the internal capital market operates. This section attempts to establish the importance of the internal capital market in reallocating resources from industry to industry. Is it the case that the large firm simply moves resources to areas of new opportunity impersonally and without regard to its line of business? Is it simply a more efficient substitute for the capital market?

Much of the evidence on this question is due to Berry (1975) who reasoned that, if there are economies in the disposition of capital, the large firm will be the most likely new entrant into a given line of business. Given any set of incentives to enter, the latter will attract the large firm first, provided, of course, that the large firm is truly more efficient at assembling and reallocating capital. The large, multi-market firm then constitutes the most efficient mechanism for reallocating resources in response to changing social priorities. In his search for evidence that large firms are performing this traditional function of the capital market Berry asks

Is there, for example, evidence that large firms have responded - as might general purpose investment banks - to particular industry characteristics in shifting resources into or out of particular 4-digit industries as the circumstances of those industries change? If so entry and exit by these firms ought to show an association certainly with the growth of those industries and perhaps also with the size, concentration, and ease with which those industries may be entered or abandoned. If, on the other hand, such inter-industry movements

by major corporations are influenced or determined chiefly by factors specific to the firm, such an overall relationship between entry or exit and the characteristics of individual industries would not necessarily be expected. (p.122)

In his investigation of the pervasiveness of the internal capital market, Berry examines the determinants of inter-industry differences in new entry among 461 corporations taken from the Fortune Five Hundred list. He finds that net entry by these large corporations is only weakly related to industry growth and to factors representing the "ease of entry". He concludes that inter-industry differences in the rate of entry by large firms are almost entirely random (p.143) and that the factors governing entry must therefore be specific to the firm itself. The notion that the large firm allocates capital wherever the opportunity arises, quite independent of the type of business involved is, in Berry's view, an exaggeration.

This conclusion is not entirely fair. Berry has not shown that new investment in general responds to the industry characteristics--past growth and profitability for example--he has measured. Until he can show that the allocation of capital across industries shows some systematic pattern while new entry by the largest firms does not, he can not claim to have shown that the largest firms are not performing a generalized capital market function.

In a Canadian context information on the extent of new entry by industry and the characteristics of new entrants

would be helpful. If large firms constitute a disproportionate fraction of new entrants and their entry is not confined to closely related activities, it may be inferred that the large firm is, in part, a substitute for the capital market.

Collection of this type of information has barely begun. The rate of new entry (new entrants:existing firms) for 1973 has been calculated and is reported in Table XV. New entrants in 1973 were assigned to two categories, those which were corporations large enough to report to CALURA (assets greater than \$5 million) in 1972 and those which were not. The fraction of new entrants large enough to have reported to CALURA was calculated and regressed on the capital requirements for entry. The latter was calculated in the manner suggested by McFetridge (1973). It was found that capital requirements for entry and the fraction of entrants big enough to have reported to CALURA are positively correlated ( $r = .59$ ) and that, on average, one-fifth of all new entrants were big enough to report to CALURA in the year prior to their entry.

With regard to the importance of the large firm in facilitating the capital allocation process, the conclusion must be that they were numerically unimportant. Four-fifths of the new entrants were firms with assets under \$5 million the year prior to their entry. More important is the fraction of the resources committed to new entry controlled by large and small firms. Since there is no evidence on this point, the question of the importance of the large firm in the process of reallocating resources is unresolved.

It has also been found that the new entrant is the more likely to be a large firm (large being one with assets in excess of \$5 million) the greater the capital requirements for entry. This says less about the importance of the internal capital market than it does about the economies of scale in the assembly of capital, the topic of Section 3.2. It does imply that there are economies of scale in the assembly of capital. It does not indicate whether these economies continue beyond \$5 million asset size class. This is the issue which is important for policy purposes and it too remains unresolved.

TABLE XV  
Rate of New Entry, Manufacturing Industries,  
Canada, 1973 (in per cent)

<u>Sic Number</u>	<u>%</u>	<u>Sic Number</u>	<u>%</u>	<u>Sic Number</u>	<u>%</u>
101	4.69	239	5.15	294	2.56
102	5.01	243	5.79	295	6.67
103	1.89	244	7.01	296	11.27
104	0.52	245	5.44	297	0
105	1.54	246	3.43	298	8.86
106	3.80	248	0	201	8.33
107	2.95	249	3.39	302	1.90
108	2.40	251	13.09	303	6.05
109	4.22	252	4.49	304	5.59
151	0	254	11.62	305	4.12
153	3.23	256	10.19	306	7.76
162	2.07	258	2.33	307	5.75
165	11.76	259	6.23	308	6.24
172	3.23	261	10.14	309	7.98
174	2.29	264	10.29	311	3.70
175	0	266	4.93	315	6.92
179	5.10	268	9.23	316	2.50
181	0	271	2.92	318	10.61
182	0	272	6.25	321	4.17
183	5.56	273	4.54	323	2.08
184	5.00	274	1.65	324	8.48
185	2.94	286	8.10	325	7.04
186	22.22	287	6.87	326	0
187	5.49	288	16.05	327	0
188	0	289	2.32	328	14.64
189	6.44	291	0	329	17.95
231	3.53	292	0	331	3.85

TABLE XV (continued)

<u>Sic Number</u>	<u>%</u>
332	7.50
333	6.07
334	3.45
335	9.64
336	1.89
338	7.50
339	8.67
351	5.56
352	2.63
363	10.99
354	5.73
355	3.77
356	4.59
357	0
358	21.43
359	5.65
364	1.45
369	6.98
372	9.46
373	2.22
374	4.76
375	3.25
376	3.33
377	0
378	5.70
379	5.13
391	9.30
392	5.48
393	9.48
397	8.59
399	6.75

SIC codes are identified in Table I Section 1.5.3

### 3.4 SIZE AND THE ABILITY TO BEAR RISK

#### 3.4.1 Introduction

It is often noted that large firms are less "risky" than small firms and that risk reduction is a motive for and should be a defence for conglomerate mergers and large size in general. This chapter reports the results of an investigation of this issue. It includes a definition of risk, determination of the conditions under which an increase in firm size reduces risk, a summary of the evidence on the size-risk relationship in a Canadian context, an alternative risk measure, and, a discussion of the legitimacy of risk reduction as a defence for mergers and for large size per se.

#### 3.4.2 Risk: A Definition

If one were to undertake an activity which has only one possible outcome the outcome is said to occur with a probability of one and the activity is said to be riskless. If one were to undertake an activity with a range of possible outcomes each of which occurs with a probability greater than zero but less than one, this activity is said to be risky. The range of possible outcomes and their respective probabilities of occurring is given, in summary form, by the probability distribution of these outcomes. An activity involving risk is

then one in which the outcome is subject to a probability distribution. The more concentrated is this distribution about a single outcome, the more likely it is that this outcome will occur and the smaller is the risk associated with the activity. Conversely, the greater the dispersion of possible outcomes the lower is the probability of the occurrence of any given outcome or range of outcomes and the greater is the risk associated with the activity.

A summary measure of the dispersion of the outcomes--hence the risk associated with a given activity--is provided by the variance of the probability distribution of these outcomes: the greater the variance of this distribution, the greater the risk associated with the activity which generated it.

To provide an example of this one might take as an activity an investment which is the allocation of resources to the creation of an asset which yields a flow of services to society and thus an income to its owner over time. The flow of income and thus the owner's rate of return during each of these subsequent periods is then the outcome of the activity. Because there are a range of rates of return which may be earned each year, these rates of return and their respective probabilities can be given in the form of a probability distribution: the greater the variance of this distribution, the greater the risk associated with the investment.

The same reasoning holds for a firm. The rate of return to the owners takes on a range of values with a relative frequency given by its probability distribution: the greater

the variance of this distribution, the riskier is the firm.

It is generally assumed that if individuals have a choice between two income streams with the same average (expected) value, they will prefer the less risky (lower variance) stream. They could be induced to choose the riskier stream only if it has a higher expected value. The increase in the expected value of the risky stream which is sufficient to make investors indifferent between these two streams is a measure of the cost, to the individuals involved, of bearing risk and can be called a risk premium. A reduction in variance of a firm's income stream reduces the risk its owners must bear. As a result the cost of risk-bearing is reduced and the owners of the firm experience a gain in the sense that others are now willing to pay more for the income streams to which the former have title.

### 3.4.3 Risk and Firm Size

Let the rate of return earned by the owners of a firm be  $\pi$  which takes on various values with a relative frequency given by its probability distribution. Let the variance of this distribution be  $\sigma^2$  which is calculated (in discrete terms) as

$$\sigma^2 = \sum_{i=1}^n (\pi_i - \bar{\pi})^2 P(\pi_i) \quad (1)$$

If this firm were comprised of two equal sized divisions A and B, the rate of return earned by the firm would be

the average of the two divisional rates of return or

$$\pi^* = \frac{1}{2}\pi_A + \frac{1}{2}\pi_B \quad (2)$$

and the variance of  $\pi^*$  is

$$\begin{aligned} \text{var}(\pi^*) &= \text{var}\left(\frac{1}{2}\pi_A + \frac{1}{2}\pi_B\right) \\ &= \frac{1}{4}\text{var}(\pi_A) + \frac{1}{4}\text{var}(\pi_B) \end{aligned} \quad (3)$$

provided the income streams of the two divisions are independent. If the variance of each income stream is  $\sigma^2$  then the variance of the combined stream is  $\sigma^2/2$ .

In general a firm with  $n$  independent divisions of equal size each of which had an income stream with variance  $\sigma^2$  would have a combined income stream with a variance of  $\sigma^2/n$ .

It is unlikely that the divisions or more generally, income sources will be of equal size. If a firm has  $n$  independent income sources each of which contributes some share  $S_i$  such that  $\sum S_i = 1$  to its income stream the variance of its rate of return would be

$$\begin{aligned} \text{var}(\pi) &= \text{var} \sum_{i=1}^n S_i \pi_i \\ &= \sum S_i^2 \text{var}(\pi_i) \\ &= \sigma^2 \sum S_i^2 \end{aligned} \quad (4)$$

which is less than  $\sigma^2$  provided  $0 < S_i < 1$  for all  $S_i$ . Again, the grouping of independent income streams reduces the risk associated

with the aggregate stream. Note that  $\sum S_i^2$  can be viewed as a Herfindahl-Hirschman index of diversification. The greater the average share of each income source in the total and the greater the inequality in shares, the greater is  $\sum S_i^2$  and the smaller the risk reduction from diversification.

The income streams earned from various sources may not be independent. It can easily be shown, however, that, unless the income streams are perfectly correlated, the variance of the firm's rate of return is less than the sum of the variances of the divisional rates of return. Consider, for example, the two division firm with

$$\pi^\nabla = S_A \pi_A + S_B \pi_B$$

$$S_A + S_B = 1$$

$$\rho(\pi_A, \pi_B) \neq 0$$

$$\text{var}(\pi_A) = \text{var}(\pi_B) = \sigma^2$$

then

$$\text{var}(\pi^\nabla) = (S_A^2 + S_B^2 + 2S_A S_B \rho) \sigma^2 \quad (5)$$

If  $\rho=1$ , the rate of return streams are perfectly correlated, the expression in the brackets equals one and the variance of the aggregate rate of return stream is the same as the variance each of the individual rate of return streams. There has been no risk reduction. For any  $\rho$  less than one, the expression in the brackets is less than one and the variance of the firm's rate of return is less than the variance of either of the individual rate of return streams.

The foregoing indicates that there will be an inverse relationship between risk and diversification. To obtain a relationship between risk and size one must assume a relationship between diversification and size. The simplest assumption is that the number of independent rate of return streams or profit centres is proportional to the size (net assets) of the firm. That is

$$n_i = k_1 A_i \quad (6)$$

so that, if the streams are independent and each has variance  $\sigma^2$ , the variance of the rate of return of the  $i^{\text{th}}$  firm is

$$\sigma_i^2 = \sigma^2/n_i = \sigma^2/k_1 A_i \quad (7)$$

Making the additional (heroic) assumption that all divisional rate of return streams have variance  $\sigma^2$  regardless of the firm to which they accrue allows the rewriting of (7) as

$$\sigma_i^2 = k_2/k_1 A_i = \phi/A_i + v_i \quad (8)$$

The variance of divisional rate of return streams need not be constant: Equation (8) could also be specified with  $\phi$  as a function of a number of other variables such as leverage, both financial and operating, and the variability of demand. If one has no theoretical grounds for specifying such a relationship an equation such as (8), in which any inter-divisional risk differences are assumed to be random will suffice.

The proportionality hypothesis stated above can be

tested, albeit nonstatistically, with two variance and two asset observations. Given firms (or size classes) 1 and 2 with variances  $\sigma_1^2$  and  $\sigma_2^2$  and assets  $A_1$  and  $A_2$  respectively, equation (7) implies that

$$\frac{\sigma_2^2}{\sigma_1^2} = \frac{A_1}{A_2} \quad (9)$$

or that

$$\frac{\sigma_2}{\sigma_1} = \left(\frac{A_1}{A_2}\right)^{.5} \quad (10)$$

This "test" has been conducted with both intraclass profit rate variances and time series profit rate variances by a number of authors. A description of this and other facets of their work appears in the following section.

#### 3.4.4 Existing Evidence on the Size-Risk Relationship

Steckler (1965) employed grouped data to investigate the relationship between (asset) size and (a) variability of rates of return among firms in a given size class at one point in time and (b) the variability of the size class average rate of return over time. The relationship between size and intra-class variability of the rate of return is illustrated in Table XVI.

Although Steckler does not test the proposition formally, inspection of Table XVI reveals a general tendency for intra-class variation in rates of return to fall as the size of the firms in the class increases.

The variability of rates of return over time is also calculated for each size class by Steckler. He finds that the time variation in the rates of return is similar for each size class. The period over which time variation was measured was relatively short, 1947-1951, and all firms making losses were excluded. Since the fraction of firms making losses at troughs in the business cycle is largest in the smallest size class, the time variation of rates of return in the smaller size classes will be understated relative to that in the larger classes. The nature of the relationship between size and the time variability of rates of return is therefore not established by Steckler's work.

Sherman (1968) calculates the time variability of profit rates by size class over a longer period of time and includes firms earning losses in this calculation. The results are given in Table XVII. The standard deviation of the rate of return over the period 1931-1961 is generally smaller for the size classes containing the larger firms. Again no statistical test is conducted so that the difference may not be statistically significant.

With respect to intraclass variation in rates of return, Sherman's findings confirm those of Steckler (see Sherman pp.116-7). The variation of rates of return among firms in a given class falls as the size of the firms in the class increases.

The reasons given by Sherman for this occurrence have

TABLE XVI

MEAN AND STANDARD DEVIATION OF  
 RATES OF RETURN BY SIZE CLASS  
 FOR PROFITABLE U.S. MANUFACTURING  
 CORPORATIONS, 1955 and 1958.

<u>Asset Size ('000\$)</u>	<u>Mean Rate of Return</u>		<u>Standard Deviation</u>	
	<u>1955</u>	<u>1958</u>	<u>1955</u>	<u>1958</u>
0-25	12.0	12.6	27.4	13.8
25-50	10.6	11.1	13.0	14.5
50-100	10.8	9.8	11.1	11.4
100-250	10.4	9.1	9.0	8.6
250-500	10.5	9.2	8.6	8.0
500-1,000	12.1	9.7	9.4	8.4
1,000-2,500	12.6	10.4	8.9	8.1
2,500-5,000	13.0	10.8	8.4	8.0
5,000-10,000	13.6	11.2	7.7	7.3
10,000-25,000	14.4	11.3	6.7	6.2
25,000-50,000	14.1	10.5	7.5	6.5
50,000-100,000	12.8	9.9	7.0	6.9
100,000-250,000	13.2	10.0	7.2	6.0
250,000 or more	11.1	7.1	5.0	4.3

(Source: Steckler (1964) p. 1187)

been discussed earlier. In his words

... random factors may make a particular small one plant firm very successful or very unsuccessful. In a large multiplant firm, however, random factors will cancel out leaving a tight distribution around the mean at that asset size ... one should view the large corporation as the aggregation of a number of individual enterprises some of which have losses and some of which are profitable (pp.118-9).

Sherman concludes his analysis of intraclass variation in rates of return by testing the proposition discussed in section 3.4.3, that the variance of rates of return is inversely proportional to the size of the firm. If it is the case that

$$\sigma_i^2 = k A_i^{-1}$$

then, for any two size classes 1 and 2, it must be the case that

$$\frac{\sigma_2^2}{\sigma_1^2} = \frac{k/A_2}{k/A_1} = \frac{A_1}{A_2} \quad (12)$$

where  $\sigma_1^2$  and  $\sigma_2^2$  are the intraclass profit rate variances of asset classes 1 and 2 respectively and  $A_1$  and  $A_2$  are the class midpoints of asset classes 1 and 2 respectively.

Sherman (pp.119-20) finds that the predicted relationship is approximated by that observed among the smaller size classes but not among the larger size classes. Variance declines less than predicted among the larger asset size classes.

TABLE XVII

## PROFIT RATE VARIATION OVER TIME:

ALL U.S. CORPORATIONS, 1931-61

<u>Asset Class lower limit (000\$)</u>	<u>Standard Deviation of Profit Rate (Per cent)</u>
0	11.15
50	7.62
100	7.62
250	7.54
500	7.80
1,000	7.60
5,000	7.17
10,000	6.85
50,000	5.68

Source: Sherman (1968) Table 7-1.

According to his theoretical discussion, there could be two reasons for the deviation between the predicted and actual relationship. The first is that, although the number of independent "profit centres" increases proportionally with firm size, they become more unequal in size so that the index of diversification ( $\sum s_i^2$ ) falls less than proportionally. The second is that although the number of equal sized "profit centres" increases proportionally with firm size, their independence decreases ( $\rho$  increases) and, as a result, the variance of rates of return declines less than proportionally.

Samuels and Smyth (1968) have investigated the size-risk relationship among British corporations. They found, first, that the variability of size class profit rates over time declined as the size of the firms in the class increased (p.135), second, that intraclass variability of rates of return was smaller in the size classes which included the larger firms (p.136) and third, that the decline in variation though statistically significant, was smaller than that predicted by the proportionality hypothesis (p. 137).

Similar results were obtained by Hymer and Pashigian (1962) when they compared the standard deviation of growth rates, rather than profit rates, across size classes. It was found that the former declined as average firm size increased but not to the extent predicted by the proportionality hypothesis (pp.568-9). The authors attribute their finding to the existence of a relationship among all the activities of a firm. Large firms are apparently not mere collections of independent firms.

### 3.4.5 The Size-Risk Relationship in a Canadian Context

In order to determine the relationship between firm size and risk, the variability of the rate of return or, more specifically, the standard error of the annual rate of return on equity over the period 1961-74 was calculated for a sample of 197 Canadian public companies. When the assets of the sample companies are averaged over the period 1961-65 they range from \$1.04 million to \$1,913.07 million with a first quartile of \$11.23 million, a median of \$31.9 million and a third quartile of \$116.9 million.

According to the theoretical discussion in section 3.4.2 and 3.4.3 and the empirical evidence summarized in section 3.4.4, the standard error of the rate of return should decline as firm size increases so that the functional relationship

$$\ln \sigma_i = k_0 + k_1 \ln A_i + u_i \quad (13)$$

should be observed. If as hypothesized, the variance of the rate of return is inversely proportional to assets then the standard error should be inversely proportional to the root of assets and  $k_1$  will be equal to .5.

To this point it has been assumed that the degree of diversification is proportional to the size of the firm. It is the case, however, that firms of a given size may participate in a different range of industries and thus be diversified in the conventional sense of the word, to a different extent. This implies that participation in a broad range of industries will

itself reduce the risk incurred by the owners of a firm of any given size. To test this proposition the summary diversification measure

$$V_i = \sum_{j=1}^J DI_j + 2 \sum_{k=1}^K DM_k + 3 \sum_{l=1}^L DS, \quad (14)$$

where  $DI =$  one for each three digit industry in which the  $i^{th}$  firm operates, other than the industry to which it is assigned, and which is in the major group to which it is assigned.

$DM =$  one for each three digit industry in which the  $i^{th}$  firm operates which is outside the major group but inside the sector to which the  $i^{th}$  firm is assigned.

$DS =$  one for each three digit industry in which the  $i^{th}$  firm operates which is outside the sector to which it is assigned.

and  $J+K+L \leq 5$

is added to equation (13).

Estimation of (13) yields

$$\ln \hat{\sigma}_i = -2.602 - .116 \ln A_i \quad (15)$$

(22.43)    (4.71)

$$F(1,195) = 15.43$$

while estimation of (13) with the diversification measure,  $V_i$ , yields

$$\ln \hat{\sigma}_i = -2.722 - .119 \ln A_i + .035 V_i \quad (16)$$

(22.41)    (4.12)    (2.84)

$$F(2,194) = 12.04$$

For a smaller subsample which excluded all holding companies the estimate of (13) was

$$\ln \hat{\sigma}_i = -2.730 - .114 \ln A_i + .039 V_i \quad (17)$$

(22.70)      (3.60)      (2.78)

$$F(2,151) = 9.63$$

These results confirm the predicted negative association between size and risk. The coefficient of the logarithm of assets is significantly less (in absolute value) than .5. The standard error of the rate of return falls as firm size increases but at a much lower rate. The coefficient of the summary diversification index,  $V$ , is positive and significant at the 10% level. This implies that given firm size, the wider the range of industries in which a firm operates the greater is the variation in its rate of return over time. This conclusion is unexpected and may be due either to the crude nature of the diversification measure or the overstatement by the standard error about the mean of the variability of the profit rate of firms which have experienced rising profit rates. If firms which have diversified across industries have, in general, experienced increases in their rate of return this relationship would be observed.

#### 3.4.6 An Alternative Measure of Risk

There is a school of thought that would dispute the measure of risk employed above. Adherents to this school would argue (see Jensen (1972) and the references therein for details) that the risk borne by the owner of a title to a given income is not a function of the variance of that stream,  $\sigma^2$ , or of any

other measure of the variability of that stream. The holder of a title to an income stream bears risk only to the extent that there exists a variability in that stream which can not be diversified away. An asset may generate an income stream with a high variance but when that income stream is combined with another, the resulting stream may have a zero variance. This can be illustrated by evaluating expression (5) when  $S_A = S_B$  and  $\rho = -1$ . The riskiness of a given income stream thus depends on its covariance with other income streams rather than its own variance. The greater its covariance with other income streams the less is the extent to which its combination with other income streams can reduce the variability of the combined stream.

As a generalized measure of the extent to which the variability of the  $i^{\text{th}}$  income stream can not be diversified away by combining it with other income streams investigators in this area have employed the so-called "beta coefficient" which is defined as

$$\beta_i = \text{COV}(\pi_i, \pi_M) / \sigma_{\pi_M}^2 \quad (18)$$

where  $\pi_i$  = rate of return to the  $i^{\text{th}}$  asset

$\pi_M$  = rate of return to a portfolio of assets

$\beta_i$  can be defined intuitively as the covariance of the  $i^{\text{th}}$  income stream with an aggregate or portfolio income stream expressed as a fraction of the variance of the aggregate stream. This provides a normalized hence comparable measure of the extent to which the returns to the  $i^{\text{th}}$  asset ( $i = 1 \dots n$ ) vary

with all other assets and, consequently, the extent to which the variability of the  $i^{\text{th}}$  income stream can not be diversified away.

If  $\beta_i$ , nondiversifiable risk, is the correct measure of the risk which must be borne by the owners of the  $i^{\text{th}}$  firm, then the finding, in section 3.4.5, that large firms have less variable profit rates than small firms does not imply that large firms are less risky than small firms. Since a lower value of  $\sigma_i$  does not imply a lower value of  $\beta_i$ , lower values of  $\sigma_i$  do not imply any reduction in the risk which can be diversified away and which the owners of the  $i^{\text{th}}$  firm must ultimately bear.

The observation of a negative relationship between firm size and nondiversifiable risk would support the inference that the risk borne by the owners of large firms is less than that borne by owners of small firms. In order to ascertain whether such a relationship exists an estimate of nondiversifiable risk,  $\hat{\beta}_i$ , was obtained for each of the 197 public companies examined above.  $\hat{\beta}_i$  was obtained by regressing the rate of return earned by the  $i^{\text{th}}$  firm on the rate of average return earned by all industrial companies over the 14 year period 1961-1974. This yields  $\hat{\beta}_i$  values which can be expressed operationally as

$$\hat{\beta}_i = \frac{\sum_{t=1}^{14} \pi_{it} \pi_{mt} - 14 \bar{\pi}_i \bar{\pi}_m}{\sum_{t=1}^{14} \pi_{Mt}^2 - 14 (\bar{\pi}_M)^2} \quad (19)$$

Given  $\hat{\beta}_i$  values, the size-risk relationship can be found by re-estimation of equation (13) with  $\hat{\beta}$  as the dependent

variable. This yields

$$\hat{\beta}_i = 1.218 - .0137 \ln A_i \quad (20)$$

(4.36)      (0.19)

$$F(1,195) = 0.037$$

When the subsample which excludes holding companies is employed, the estimate of (13) becomes

$$\hat{\beta}_i = 1.074 + .0204 \ln A_i \quad (21)$$

(3.74)      (0.28)

$$F(1,152) = 0.081$$

In neither case can it be inferred that the effect of size on risk,  $d\beta/dA$  differs significantly from zero. If risk is to be measured in terms of the variability of an income stream which can not be diversified away, big firms are no less risky than small firms. Taken together these results imply that large size does result in a reduction in random fluctuations in income ( $d\sigma/dA < 0$ ) but does not decrease the degree to which the firm is subject to market wide fluctuations. In attaining large size firms do not appear to have engaged in new activities which might be expected to be successful during periods when present activities were less successful.

#### 3.4.7 The Policy Relevance of Size-Risk Relationships

Assume, for the moment, that there exists both a mutually agreed upon measure of risk and an unambiguous negative

relationship between firm size and risk. Although much stronger than those obtained here, results such as this would not provide sufficient grounds for a defence either for mergers or large size per se. The first reason for this is that, although risk can be reduced by grouping a number of activities the returns to which are less than perfectly correlated, this does not require a merger. The owners of a firm can achieve all the risk reduction which can be achieved via the merger route by buying shares in other firms, that is, by diversifying their own portfolios. The only defence for the conglomerate, then, is that it allows its owners to diversify at lower cost than they could through the market. In this regard the conglomerate is likely to have no advantage over the mutual fund and is likely to have one important disadvantage. If it is to be more than simply a holding or investment company it must own a controlling interest in all affiliates. The conglomerate shareholder must therefore hold the shares in all the conglomerate's affiliates and in proportions other than that which he may prefer in his portfolio. The conglomerate therefore reduces the transaction costs of diversifying but limits the nature of the diversification which can take place; Levy and Sarnat (1970) have investigated the circumstances under which the latter influence prevails and a conglomerate merger makes owners of the firms involved worse off. The result obviously depends on the transaction costs saved and the deviation between the ideal and the implied conglomerate portfolio.

A second argument is that even if the conglomerate is

the low cost method of achieving a risk reducing portfolio diversification and therefore makes the shareholders involved better off, it does not make society better off. This is because risk bearing is alleged to be a cost to individuals but not to society. From a social point of view there is no risk. Steiner (1975) takes this view. Concluding that "... risk avoidance is a private rather than a public benefit and does not therefore seem to me to yield a real economy. Indeed because it is a private benefit, private companies may by diversification produce social diseconomies while avoiding private costs. Individual owners can reduce their risk by an appropriate diversification of their stock holdings." (p.68).

The argument that risk bearing is a private but not a social cost has two facets. First, when all the risky activities of society are considered those with good outcomes will be cancelled by those with bad outcomes so that the outcome of this aggregation of activities will not, in the limit, deviate from some average value. The probability distribution of the outcomes collapses around some average outcome. From a social or aggregate point of view there is only one outcome, the average outcome, and therefore no risk. Second, when society as a whole undertakes a risky activity the portion of the risk born by any one member of society is sufficiently small that the cost to him of bearing it is infinitesimal. In the limit the aggregation of the infinitesimal cost incurred by each member of society is itself infinitesimal (Arrow and Lind (1970)).

In summary, risk reduction is not generally construed

as a defence for a merger or large size per se because the risk reduction achieved within the firm could have been achieved by its owners through manipulation of their own portfolios and because risk reduction benefits those who bear it but not society as a whole. Neither of these pillars of the conventional wisdom is beyond dispute. The relative costs of risk reduction via merger and via the capital market are simply not known. The argument that the cost of risk bearing is a private but not a social cost is, in the view of a number of authorities (for example, Bailey and Jensen (1972) and McPettridge (1977)), incorrect. According to this view the private and social costs of risk bearing are the same. The extent to which risk can be diversified away, whether collectively or by individuals in the market, depends on the statistical relationship among the outcomes of the various activities undertaken in society. The extent to which risk actually is diversified away, whether by society or by individuals operating through markets, depends on the moral hazard and transactions costs of risk spreading or risk sharing. The remaining risk can be ignored neither by individuals nor the collectivity. In this case a risk reduction which could be achieved only via merger confers a benefit on society and is thus a merger defence.

#### 3.4.8 Conclusion

It has been established that, in the sense that their rate of return is less variable over time, large firms are less

risky than small firms. This is consistent with the findings of investigators in other countries. It has also been argued that the true measure of risk associated with any income stream is not its own variability but the extent to which its variability can not be diversified away. It was found that in this sense large firms are as risky as small firms. The implication is that owners of large firms have more protection against random fluctuations in their incomes (due, for example, to machinery breakdowns) but no more protection against the business cycle than have the owners of small firms.

It is concluded that, while any risk reduction constitutes a real (social) benefit, there exists no evidence as to whether mergers or individual portfolio diversification is the less costly method of effecting a risk reduction.

# Notes: Chapter 3

$$1. \quad V_i = \sum_{j=1}^J DJ_j + 2 \sum_{k=1}^K DK_k + 3 \sum_{l=1}^L DL_l$$

where  $DJ = 1$  for each three digit industry, other than the industry to which it is assigned, in which the  $i^{th}$  firm is operating and which is within the major group to which the  $i^{th}$  firm has been assigned,

$DK = 1$  for each three digit industry in which the  $i^{th}$  firm is operating which is outside the major group but within the sector to which the firm is assigned,

$DL = 1$  for each three digit industry in which the  $i^{th}$  firm operates which is outside the sector to which the firm is assigned.

$$J+K+L < 5.$$

Industries in which each firm operates are taken from Dun and Bradstreet (1975). The industry to which each firm is assigned (its home industry) is obtained from Dun and Bradstreet and by special correspondence with Statistics Canada. Firms are assigned by the latter to a "home" three digit industry which is the industry in which the largest fraction of the firm's value adding activity occurs. "Firm" is taken to mean corporate entity so that  $V_i$  does not reflect the diversification of the enterprise with which the  $i^{th}$  corporate entity is linked. Nor does it distinguish between vertical and conglomerate diversification in the manner discussed in Section 1.5.3.

2. Results reported in this section are reported in greater detail in McFetridge (1976).



## SIZE AND PROGRESSIVENESS

## 4.1 INTRODUCTION

Technical progress can be viewed as one of many capital goods in which a society may invest. A society which forgoes current consumption to invest in the development of new techniques can expect to be rewarded with higher levels of consumption in the future. There is a school of opinion which holds that the rate at which current abstinence can be transformed into future consumption depends, in part, on the mode of organization of productive activity. Specifically, that:

(a) a given postponement of current consumption yields more in terms of future consumption if society is composed of large organizational units and (b) because the postponement of additional consumption to invest in new techniques yields more in terms of future consumption, self-interest will lead a society organized in large units to devote relatively more of its resources to the development of new techniques.

In its simplest terms the argument is that big firms are better than small firms at doing research and, because they are better at it, they do more of it. While it has received the most attention the second effect is, for reasons given in Section 4.3, a possible but not a necessary consequence of the first. That is, evidence that large firms do proportionately more research is not evidence that the latter obtain more innovations from a given set of research

resources. Since the defence for both mergers and large size per se must surely be that the largest unit uses research resources more efficiently, evidence on the research expenditures of large firms is irrelevant and it receives only the briefest attention here.

The argument that, ceteris paribus, the rate of technical progress is greater in a society organized into large firms is often labelled "the Schumpeterian argument". What Schumpeter actually had to say on the subject was

... there are superior methods available to the monopolist which either are not available at all to a crowd of competitors or are not available to them so readily: for there are advantages which, though not strictly unattainable on the competitive level of enterprise, are as a matter of fact secured only on the monopoly level, for instance, because monopolization may increase the sphere of influence of the better, and decrease the sphere of influence of the inferior, brains, or because monopoly enjoys a disproportionately higher financial standing.

There cannot be any reasonable doubt that under the conditions of our epoch such superiority is as a matter of fact the outstanding feature of the typical large scale unit of control, though mere size is neither necessary nor sufficient for it. (1950, p.101).

The assessment of the validity of the arguments of both Schumpeter and those who followed him and the establishment of conditions, if any, under which it can truly be said that, for any given investment in research, the rate of technical progress is greater in an economy characterized by large firms is the task of the next section. Sections 4.3 and 4.4 contain a summary and analysis of what crude evidence exists on the relationship between firm size and innovative activity in Canada.

## 4.2 SIZE AND PROGRESSIVENESS: THEORY

The statement that big firms are more or less progressive than small firms, as it stands, has no content. It is necessary, first, to define progressiveness. In this study, a progressive firm is one which introduces either products which augment the range of choice available to the community or changes in the organization and/or method of production which results in resource savings. Among the possible indicators of progressiveness are: (i) the number of product or process innovations a firm has made; (ii) the number of technically significant innovations made, Mansfield (1968); (iii) the value of innovations made, Comanor (1967); (iv) the number of patentable inventions made, Scherer (1965). Big firms are more progressive than small firms if an increase in firm size results in a more than proportional increase in one of these measures of innovative activity.

It is commonly held that the advantage of the large firm stems from the existence of physical indivisibilities in the research and development (R&D) function. The existence of such indivisibilities implies that resource requirements will increase less than proportionately with the size of the research task undertaken. The small research task will be proportionally more costly than the large research task. The usual example is that of a process innovation, the cost of which can be applied over a larger output, the larger is the

firm. This does not result in a disadvantage to the small firm if the latter can sell the rights to the innovation to other producers which, in effect, spreads its cost over a larger output. The existence of physical indivisibilities in the R&D function is, therefore, not in itself sufficient to put the small firm at a disadvantage relative to the large. The disadvantage arises from the existence, for any reason (see Section 1.4 page 14 for a list), of economies of scale in the R&D function together with significant costs of transacting in the rights to innovations or in R&D services per se.

A small firm can spread the cost of a process innovation over a larger output only by licencing it to other firms or engaging in joint ventures. Since the larger firm need not do this, it holds an advantage over the small firm equal to the costs of negotiating and enforcing licencing or joint venture arrangements. Similarly, the benefits of specialization or the economies of dimension are available to the small firm only if it incurs the transactions costs associated with engaging the services of outside R&D specialists: again, the large firm need not incur these costs.

In sum, it is the combination of economies of scale in the R&D function and relatively high costs of transacting both in the rights to innovations and in R&D services per se which has the effect of increasing R&D costs disproportionately as firm size decreases. After a survey of the evidence

Vernon (1970) concludes that there are both economies of scale in R&D and significant costs to trading in both R&D inputs and output. With regard to the latter he writes

... there appear to be powerful drives toward a firm's internalizing some of the external economies associated with the availability of research facilities especially when the research is immediately related to industrial innovation. One, quite obviously, is the need for secrecy. Another is the requirement of availability. When an outside facility has more business than it can handle, the firm can not be sure of its influence over the outside facility's priorities ....

Some striking experimental evidence suggests still another very powerful force pushing the internalization of industrial research - the problem of effective communication among the participants. In such research, face-to-face communication is the preponderant means for transmitting information and ideas. Although the evidence is still fragmentary, it provides strong indications that individuals are much more prepared to receive and accept messages emanating from those whom they consider part of "their organizations" than those whom they regard as "outsiders". (p.58).

In the terms employed here Vernon's suggestion is that, because the participants are, in a sense, certified, the cost of information exchanges within a firm will be lower than the cost of market exchanges. If this is the case, the larger firm will be aware of a greater range of profitable applications for a given piece of research than will the small firm. Thus, not only is the large firm less likely to have to bear the costs of licencing, etc., in order to exploit a given set of research results, it is also likely to know

a wider range of ways in which it can be exploited.

There is no absence of arguments that larger firms make less rather than more efficient use of resources devoted to R&D. If larger firms are characterized by a greater degree of separation of those doing R&D from those making decisions regarding its application, the cost of transmitting information regarding research needs down to the researchers and the cost of transmitting information regarding research capabilities up to decision makers, will be higher (Williamson 1967). The cost of forcing researchers to pursue the goals of the firm rather than their own will also be greater. The effect of this is that decision makers will use proportionately less of the output of their researchers, the latter will pursue proportionately fewer of management's objectives and a given resource commitment results in fewer inventions which are of benefit to the firm. While growth may initially involve resource savings by obviating the need for certain market exchanges, the extent of the savings will decline as firm size increases. The advantages of larger size do not continue indefinitely.

It could also be argued that the advantages of intra firm over market exchanges have been exaggerated. Co-operative research ventures are common. One of many examples of this type of joint venture is the Mining Industry Research Organization of Canada (MIROC) which is a

... new research organization [which] has been established by six major Canadian mining companies to develop improved mining technology .... To

apply the best available technology MIROC will contract specific tasks to research organizations already active in the mining industry or others that can contribute to its objectives. (Canadian Mining Journal, May, 1976, p.80).

The pervasiveness of joint ventures of this nature makes it difficult to establish the case that increases in firm size among already large firms are necessary for the efficient use of research resources.

There are some other, more traditional, arguments that innovative activity will increase more than proportionately with firm size. Some writers, invoking Schumpeter, have argued that large size implies a large market share hence a greater ability to internalize the benefits of an invention. This argument has a number of flaws. Large size is neither necessary nor sufficient to ensure a large market share. Given an enforceable property right, the appropriability of the returns to an invention does not depend on the market share of the inventing firm. There is a licencing strategy which would enable the inventor to appropriate the entire surplus resulting from his invention. Finally, Arrow (1962) has shown that, given enforceable property rights, the incentive to invent will be smaller under conditions of monopoly than under competitive conditions.

It has also been argued that, because large firms have large internal cash flows with which to finance research activity, they will engage in proportionately more of it. This is obviously not an argument about the relationship be-

tween firm size and the efficiency with which research resources are used. It is a capital market argument of the variety considered in Section 3.2 (pp 99-100). It may be interpreted as contending that, because the large firm can raise capital at a lower cost, it will do more R&D. A lower cost of capital would lead to a greater amount of investment of all kinds, that is, to a more capital intensive factor combination. While this increase in capital intensity subsumes an increase in knowledge or R&D intensity it does not say that large firms are inherently more progressive. If large firms face different factor prices they will employ different factor combinations. To argue that large firms can raise capital at a lower cost and, because of this, do more research and are more progressive is to count the same economy twice.

An alternative interpretation is that the capital market simply will not finance research activity. If the market will not finance R&D why, one wonders, should the existing shareholders do so by allowing their profits to be retained? If there are terms under which the existing shareholders will allow their profits to be reinvested in R&D why won't the market accept these terms?

None of these interpretations of the traditional arguments constitute a credible size-progressiveness defence. Such a defence must be based on the foundation of economies of scale in research coupled with costs of transacting in research advanced at the outset.

The lower cost of intra-firm as opposed to market

exchanges of research results over some range of firm sizes. has been advanced as a reason for the prominence of multinational firms in activities where technology is both important and subject to rapid change. Bauman (1975), for example, has found that inter-industry differences in the proportion of activity accounted for by multinationals can be explained by the importance of technology and the extent to which it changes, that is, by the cost of transacting in research results. This implies that the multinational is a result of a search for a lower cost method of technology transfer and that industrial sectors in which this is an important consideration will be dominated by multinationals. Whether Canadian authorities consider this to be a legitimate defence for large size is irrelevant. Most of the changes in firm size which occur for this reason will be beyond their control. For this reason and because the amount of R&D involved is so small (see Table I) any link between size and progressiveness should be placed among the less important determinants of public policy toward large firms.

TABLE I

COMPARATIVE R&D

EXPENDITURES

(\$000)

	1971	1972	1973	1974
Dow Chemical Corp.	95,347	104,665	118,403	148,665
E.I. DuPont de Nemours and Company	258,500	265,000	285,800	344,100
Union Carbide	78,275	69,634	76,760	94,200
Canada: All Chemical Companies	82,900	84,500	92,600	103,700
Canada: Total Industrial	387,600	395,200	442,600	496,000

Sources: Moody's Industrial Manual (1975)  
Statistics Canada Cat. No. 13-203 (1976).

#### 4.3 SIZE AND PROGRESSIVENESS: BACKGROUND EVIDENCE

One crude indicator of the relationship between firm size and progressiveness is the relationship between firm size and patenting activity.<sup>1</sup> The latter is, at best, a crude indicator because the relationship between patents obtained and innovations made can vary widely over time, across firms and across industries. Some of this variability is removed by focusing attention on firms within a given industry at a point in time. Even so, there is considerable scope for error. Indeed, the reasoning in the previous section leads to the conclusion that large firms relying more on internal technology transfers will make relatively less use of formal property rights such as patents. As firm size increases, patenting activity then decreases relative to innovative output. The only defence for the size-patenting activity relationships presented in this and the next section is that there is little other information of a general nature available.

An earlier attempt to relate diversification to patenting activity is reported by Clarke (1971). Clarke examines four electrical products firms identifiable as Canadian General Electric, Canadian Westinghouse, Northern Electric and Canadian Marconi. He labels the first two as diversified and the second two as specialists. He concludes that between 1950 and 1967 the diversified firms became more so, and, among the specialists, Northern Electric did not

change while Canadian Marconi became more specialized. He then attempts to relate changes in diversification to changes in patenting activity. From the patent data reported (p.76) it would appear that increased diversification is, if anything, associated with reduced patenting activity. If these four firms are ranked each year by the number of patents they have obtained (firms with most patents assigned a rank of 1), the diversifiers go from an average rank of 1.8 during 1951-55 to 3.4 during 1963-67 while the nondiversifiers raise their average rank from 3.2 to 1.6 over the same period. Regrettably this result is misleading even as small sample evidence. The patent data employed by Clarke include patents on inventions first made by affiliates abroad. In the case of one company, Canadian patents on inventions made by foreign affiliates constitute the bulk of those obtained. There is no reason to expect changes in domestic diversification to be related, other than accidentally, to the number of inventions originating in foreign affiliates.

Some information on the relationship between firm size, diversification and the number of patents originating with the Canadian firm can be inferred from Tables II, III, and IV. These list the largest 15 companies, ranked by 1974 sales, in the electrical and chemical industries and the largest 10 companies in the machinery industry, together with the number of patents each has obtained between 1970 and 1974 and a measure of diversification.

Among the crude generalizations supported by these tables are:

- (a) At least as far as their Canadian activities are concerned, few of these companies would qualify as pure conglomerates. Of the 24 listed, only four are diversified, other than vertically, outside the manufacturing sector. On the other hand 17 are diversified in some manner outside the manufacturing major group (electrical, chemical, machinery) to which they have been assigned.
- (b) The largest companies in all three industries get the most patents. Below the three largest firms in the chemical industry and the two largest in both the electrical and machinery industries, patenting activity appears to be distributed independently of firm size.
- (c) The absence of a relationship between size and patenting activity over a broad range of firm sizes suggests that, although the largest firms obtain the most patents, larger size is neither necessary nor sufficient to ensure greater patenting activity.

To obtain a view of the size-patenting activity relationship over the full range of firm sizes in a given industry, the data on Tables II, III and IV were combined with data on smaller firms obtained from a number of sources both public and confidential. The resulting size distribution of patenting activity is reported in Table V. With the exception of the machinery industry each industry shows a general pattern of increases in the number of patents per firm as firm

TABLE II

PATENT OUTPUT: THE ELECTRICAL INDUSTRY<sup>1</sup>

Rank	Company Name	1974 Sales ('000)	Patents Originating in Canada					Diversification <sup>2</sup>				Ownership
			1970	1971	1972	1973	1974	M1	D1	M2	D2	
1.	Northern Electric Company Ltd.	\$970,711	34	24	37	36	30	0	0	1	2	C
2.	Canadian General Electric Company Ltd.	\$709,913	33	39	33	41	27	0	0	1	2	F
3.	Westinghouse Canada Ltd.	\$402,878	10	12	6	5	4	0	0	1	2	F
4.	R.C.A. Ltd.	\$173,374	0	4	0	0	1	0	2	0	2	F
5.	G.T.E. Automatic <sup>3</sup> Electric (Canada) Ltd.	\$153,338	0	0	0	0	0	0	0	0	2	F
6.	G.T.E. Sylvania Electric (Canada) Ltd.	\$148,878	0	0	0	0	0	0	0	0	2	F
7.	G.S.W. Ltd.	\$122,339	0	1	2	2	0	1	0	1	0	C
8.	Phillips Electronics Canada Ltd.	\$109,073	0	0	0	0	0					
9.	Electrohome Ltd.	\$107,057	12	15	5	9	7	1	0	1	1	C
10.	Canadian Admiral Corporation Ltd.	\$ 86,467	0	0	0	0	0	0	2	9	2	F
11.	Federal-Pioneer Ltd.	\$ 75,217	0	0	0	2	0	0	0	0	2	F
12.	Motorola Canada Ltd.	\$ 63,869	0	0	0	0	0	0	0	0	2	F
13.	Litton Systems (Canada) Ltd.	\$ 43,951	0	0	0	0	0	1	0	1	0	F
14.	Canadian Marconi Company Ltd.	\$ 42,144	3	5	4	3	3	0	2	0	2	
15.	Fleetwood Corporation Ltd.	\$ 39,100	0	0	0	0	0	0	0	0	2	F

TABLE III

PATENT OUTPUT: THE CHEMICAL INDUSTRY<sup>1</sup>

Rank	Company Name	1974 Sales ('000)	Patents Originating in Canada					Diversification <sup>2</sup>				Ownership
			1970	1971	1972	1973	1974	M1	D1	M2	D2	
1.	Canadian Industries Ltd.	\$517,586	16	13	10	10	8	0	0	1	1	F
2.	Polysar Ltd.	\$388,256	21	17	8	6	3	0	0	0	2	C
3.	Dupont of Canada Ltd.	\$368,425	20	12	12	9	14	0	0	0	2	F
4.	Union Carbide of Canada Ltd.	\$341,357	10	10	0	4	5	2	0	2	0	F
5.	Dow Chemical Company of Canada Ltd.	\$294,977	0	0	0	0	0	1	0	1	0	F
6.	Celanese Canada Ltd.	\$250,403	2	0	4	4	4	1	1	1	1	F
7.	Proctor and Gamble of Canada Ltd.	\$216,464	0	1	0	0	0	1	0	1	0	F
8.	Cyanamid of Canada Ltd.	\$135,600	1	0	0	0	0	0	0	0	2	F
9.	Monsanto Canada Ltd.	\$133,588	0	0	0	0	0	0	1	0	1	F
10.	Bristol Meyers Canada Ltd.	\$105,988	0	3	0	0	0	1	0	1	0	F
11.	Colgate-Palmolive Ltd.	\$ 92,992	0	0	0	0	0	0	0	0	0	F
12.	Allied Chemical of Canada Ltd.	\$ 92,845	0	0	0	0	0	0	0	1	1	F
13.	ERCO Industries Ltd.	\$ 84,450	6	3	9	3	3	0	0	0	0	F
14.	Canadian Liquid Air Ltd.	\$ 79,522	0	2	0	2	0	1	0	1	2	F
15.	Reichhold Chemicals Co. of Canada Ltd.	\$ 76,860	0	0	1	1	0	0	0	0	0	F

TABLE IV  
PATENT OUTPUT: THE MACHINERY INDUSTRY<sup>1</sup>

Rank	Company Name	1974 Sales ('000)	Patents Originating in Canada					Diversification				Ownership
			1970	1971	1972	1973	1974	M1	D1	M2	D2	
1.	Massey-Ferguson Ltd.	\$1,806,000	4	4	8	3	4	1	0	1	2	C
2.	International Harvester Company of Canada Ltd.	\$566,000	10	5	10	3	1	1	0	1	2	F
3.	John Deere Ltd.	\$213,106	0	0	0	0	0	0	2	0	2	F
4.	Canadian Ingersoll Rand Company Ltd.	\$119,175	5	1	1	0	0	0	0	0	0	F
5.	Clark Equipment of Canada Ltd.	\$ 80,187	0	0	0	0	0	0	0	0	2	F
6.	Versatile Manufacturing Ltd.	\$ 67,600	0	0	0	2	1	0	0	0	0	?
7.	Outboard Marine Corporation of Canada Ltd.	\$ 66,381	0	0	0	0	0	1	0	1	2	F
8.	Babcock and Wilson Canada Ltd.	\$ 64,204	0	0	0	0	0	1	0	1	0	F
9.	Dominion Engineering Works Ltd.	\$ 57,239	24	8	17	11	2	0	0	1	2	F
10.	F.M.C. Canada Ltd.	\$ 53,772	0	0	0	0	0	1	2	1	2	F

Notes to Tables II ... IV.

1. The electrical, chemical and machinery industries comprise SIC codes 331-339, 371-379 and 311-316 respectively.

2. Diversification:

M1 = 1, corporate entity diversified outside its major group but within the division.

= 0, corporate entity not diversified outside its major group.

M1 = 2, corporate entity diversified outside its major group, inside its division and diversification is largely vertical.

D1 = 0, corporate entity is not diversified outside its division.

D1 = 1, corporate entity is diversified outside its division.

D1 = 2, corporate entity diversified outside its division and diversification is largely vertical.

M2 = 0, enterprise not diversified outside its major group.

M2 = 1, enterprise diversified outside its major group but within its division.

M2 = 2, enterprise diversified outside its major group, within its division and diversification is largely vertical.

D2 = 0, enterprise is not diversified outside its division.

D2 = 1, enterprise diversified outside its division.

D2 = 2, enterprise diversified outside its division, diversification largely vertical.

For definitions of SIC major groups and divisions, see Table I, Section 1.

Sources:

- (a) Diversification: Dun and Bradstreet (1975), Statistics Canada Cat. No. 61-513 (1974).
- (b) Patents: Canada, Patent Office Record (various issues).
- (c) Ownership: Statistics Canada Cat. No. 61-513 (1974) and special correspondence.

TABLE V

## FIRM SIZE AND PATENTING ACTIVITY:

## PATENTS PER FIRM BY SIZE CLASS, 1972

Industry	SIC Codes	Size Class (1972 sales) in millions of dollars				
		0-1	1-10	10-50	50-100	over 100
Machinery	315,318	.42 (12)	.10 (31)	3.91 (11)	.50 (2)	3.00 (1)
Transportation Equipment	321,323,325	.29 (7)	.13 (16)	.14 (7)	.40 (5)	.67 (3)
Electrical Equipment	335,336	.30 (10)	.35 (20)	3.31 (13)	10.0 (1)	8.0 (2)
Chemicals	374,376,377 378	.00 (12)	.28 (32)	.74 (19)	3.67 (6)	12.63 (8)

Number of firms in the size class in brackets

Source: Patent Office Record, Department of Consumer and Corporate Affairs and private correspondence.

size increases. The important question is, of course, whether the number of patents obtained increase more than proportionally with firm size. This is difficult to gauge with grouped data. If one employs the size class mark as a measure of firm size, there is no industry in which the number of patents per firm increase more than proportionately with firm size on a consistent basis. The most nearly consistent pattern of increases in patents per firm which are more than proportionate to increases in firm size occurs in the chemical industry.

Tables II ... V convey the crude impression that, although the smallest firms generally obtain very few patents and the largest firms often obtain the most patents, across a relatively broad range of firm sizes there is no strong tendency for patenting activity to increase more than proportionately with firm size.

Another common method of investigating the relationship between firm size and innovative activity is to plot or estimate the relationship between firm size and R&D expenditures. Estimation of this relationship is discussed in Howe and McFetridge (1976). Summary evidence is provided in Table VI which indicates that R&D expenditures per firm increase with the size of the firm. Whether R&D expenditures increase more than proportionately with firm size is difficult to say with grouped data.

It should be obvious by now that even if it could be established that R&D expenditures increased more than proportionally with firm size, this would not necessarily

imply that large firms are more progressive. That is, it would not imply that, ceteris paribus, a doubling of firm size more than doubles the number of innovations a firm makes. As was argued in Section 4.2, an increase in R&D intensity could be part of an overall adjustment of capital intensity to reductions in capital costs which occur as firm size increases. If firms of all sizes face the same factor prices, finding that R&D expenditures rise more than proportionally with firm size does imply that the marginal product of resources devoted to R&D increases with firm size. Progressiveness has been defined throughout this study as an increase in the average product of R&D. A doubling of firm size more than doubles the number of innovations resulting from a given level of R&D expenditure. As long as the functional relationship between R&D inputs and output is non-homogeneous, an increase in the average product of R&D resources could be associated with a constant or decreasing marginal product of R&D. A firm could be more progressive in the sense of obtaining more innovations from a given R&D outlay and yet devote a smaller proportion of its resources to R&D. Unless the R&D input-output relationship is homogeneous, an observed increase in R&D intensity as firm size increases is neither necessary nor sufficient to imply an increase in the efficiency with which R&D resources are used. This point is elaborated exhaustively by Fisher and Temin (1973).

TABLE VI

SCIENTIFIC RESEARCH AND DEVELOPMENT  
EXPENDITURES PER FIRM BY SIZE CLASS, 1973

Industry Group	Sales Size Class (\$000)				
	1-999	1,000-9,999	10,000-49,999	50,000-74,999	over 75,000
Mines and Wells	315.0 (2)	139.4 (5)	158.2 (10)	* (3)	1943.0 (7)
Chemical Based	52.3 (25)	101.4 (85)	340.7 (71)	320.1 (10)	1358.6 (39)
Wood Based	99.0 (3)	65.5 (15)	150.4 (12)	194.7 (7)	714.1 (16)
Metals	70.3 (9)	55.5 (26)	111.3 (27)	186.0 (3)	3000.7 (12)
Machinery and Transportation Equipment	57.1 (16)	104.7 (72)	563.0 (34)	3504.8 (7)	4305.9 (10)
Electrical	106.9 (27)	212.3 (68)	1359.0 (26)	0 (0)	5773.3 (12)
Other Manufacturing	101.8 (11)	41.2 (30)	129.2 (13)	600.7 (3)	347.0 (8)
Other Industries	100.0 (120)	160.7 (326)	448.5 (202)	975.9 (33)	2098.9 (114)

Number of firms in size class in brackets.

Source: Statistics Canada, 13-203 (1976).

In summary, whatever other use they might have, estimates of the relationship between firm size and R&D spending will not support inferences regarding the relative progressiveness of large and small firms. The latter may be made from estimates of the R&D input-output relationship itself.

This section has presented some crude evidence on the relationship between patenting activity and firm size together with the limited generalizations it supports. It has considered and rejected evidence on the relationship between firm size and R&D expenditures as irrelevant to the size-progressiveness relationship. In the next section the results of a more sophisticated examination of the relationship between firm size and patenting activity are presented.

It might be argued that the concentration of the size-patenting activity relationship misses the relevant measure of progressiveness. Globerman (1975), for example, has found that large firms have a higher probability of adopting new techniques within a given time span than do small firms. The resource saving resulting from the adoption of a new technique is not necessarily an increasing function of its speed of adoption so that the latter is not to be pursued for its own sake. The real advantages to large firms in adapting to technical change appear to be few. There is the multipurpose capital rationing argument. Big firms can raise money to buy new machines, little ones can't. To the extent that it has any validity this argument should

be dealt with as a capital markets argument. It is, again, double counting to deal with it as a progressiveness argument. There may also be indivisibilities in the process of adopting new techniques. It may cost the same to adopt one or one hundred new machines. This is a clear and real advantage to the large firm. It is not clear, however, that small firms cannot achieve adoption economies by joint arrangements. Nor is it the case that the multi-market or conglomerate firm will achieve the economies of a product specific innovation. The advantage to the conglomerate must be in the economies of adopting generalized or firm wide innovations whatever these may be.

#### 4.4 FIRM SIZE AND PATENTING ACTIVITY: A MODEL<sup>2</sup>

A simple relationship between the value of past R&D inputs and current patenting activity could be written as

$$P_{it} = k_0 + k_1 \sum w_k R_{it-j-k} + \varepsilon_{it} \quad (1)$$

where  $P_{it}$  = patents obtained by the  $i^{\text{th}}$  firm during period  $t$

$R_{it-j-k}$  = R&D expenditures of the  $i^{\text{th}}$  firm during  
year  $t-j-k$

and  $\sum_{\text{all } k} w_k = 1.$

Current patenting activity is a function of past R&D activity. It is not, however, a homogeneous function. It seems reasonable to include a constant term in the model and thus allow for a situation in which inventions occur and patents are obtained without any formal R&D effort.

If the propensity to patent varies from industry to industry both  $k_0$  and  $k_1$  in equation (1) will vary from industry to industry. The practice of allowing all the coefficients in the model to differ from industry to industry is equivalent to estimating the model for each industry under investigation. For this reason equation (1) and its variants are estimated for each of the two digit S.I.C. industries under investigation. These are, as before, the electrical, chemical and machinery industries.

From a random sample of patents granted during the period under investigation it was determined that on average three years elapsed between the date on which an application for a patent is filed and the date on which it is granted. Thus, a patent obtained during period  $t$  is the result of R&D done during or before period  $t-3$ . The lag distribution on R&D should therefore begin at period  $t-3$  ( $j=3$  in equation (1)).

A large proportion of the patents obtained by firms operating in Canada is the result of the secondment to those firms of the Canadian rights to discoveries made by foreign affiliates. Since there is no reason for the number of such patents to bear a functional relationship to the R&D expenditures of the firms under investigation, they are excluded from the analysis. The dependent variable in equation (1),  $P_{it}$ , is, therefore, the number of patents for which there is either a Canadian resident inventor listed or, if the inventor resides abroad, Canada is the first nation in which patent protection has been sought, granted annually to the  $i^{\text{th}}$  firm.

The process which generates the variation, both among firms and over time, in the number of patents obtained is likely to be more complex than that implied by equation (1). If R&D personnel are viewed as working with a stock of knowledge which is fixed over a given period of time (a year in this case), the law of variable proportions will apply to the relationship between R&D expenditures and patents ob-

tained. The marginal product of R&D will be an increasing function of R&D expenditures for low values of the latter and a decreasing function of R&D expenditures for higher values of the latter. This implies that (1) be modified to allow for a non-linear relationship between R&D expenditures and patents obtained.

A second modification of (1) will be required if the number of patents resulting from a given level of R&D expenditures increases or decreases with the size of the firm within which the R&D is conducted. It was suggested in Section 4.2 that if larger firms are characterized by a greater degree of separation of those doing R&D from those making decisions regarding its application, the cost of transmitting information regarding research needs down to the researchers and the cost of transmitting information regarding research capabilities up to decision makers will be higher. The cost of forcing researchers to pursue the goals of the firm rather than their own will also be greater. The effect of this is, in the simplest terms, that decision makers will use proportionately less of the output of their researchers, researchers will pursue proportionately fewer of management's objectives and more of their own and a given level of R&D spending results in fewer inventions which are patentable by the firm. In this case firm size (as reflected by its sales,  $S$ ) should appear as an independent variable with a negative coefficient in equation (1).

If, as was also suggested, the larger firm conducts

a wider range of activities (is more diversified), the cost to it of discovering a profitable application of the results of any given R&D project may be lower. The diversified firm may also have a higher probability of finding a profitable internal use for the results of a given R&D project. Given the transactions costs associated with the sale to other firms of the rights to a new invention, the profitability of a new invention may increase with the degree to which it can be used internally. In this case the profitability and thus the incentive to continue a project until it results in patentable inventions may be greater the larger is the firm. Firm size as reflected by sales should then appear as an independent variable with a positive coefficient in equation (1).

A change in firm size may affect either or both of the marginal and the average product of R&D. If it affects only the average product of R&D  $[\frac{\partial P}{\partial S} \Big|_R \neq 0]$ , the number of patents resulting from a given level of R&D spending will change with firm size. This is the phenomenon of interest here. If an increase in firm size increases the average product of R&D, a merger will raise the number of patents which result from a given R&D budget. The larger firm is more progressive in the sense that it makes better use of a given R&D outlay.

If firm size acts on the marginal product of R&D  $[\frac{\partial^2 P}{\partial R \partial S} \neq 0]$ , the change in the number of patents resul-

ting from a given change in R&D expenditures will itself depend on the size of the firm involved. This will be of interest to those such as administrators of R&D subsidies wishing to know the class of firms in which an R&D subsidy of a given value will result in the greatest increase in inventive output. This result will also serve as a check on the relationships between R&D spending and firm size estimated under similar circumstances. If the marginal product of R&D increases with firm size, one expects to observe that, ceteris paribus, large firms will devote a large proportion of their resources to R&D than will small firms.

The modification of equation (1) must be such as to allow for the effect of firm size on both the average and marginal product of R&D. This can be done by entering firm size both additively and multiplicatively with R&D expenditures on the right hand side of (1).

For any given level of R&D expenditures and any given firm size, inventive output may differ between foreign and domestically owned firms. The inventive output which a foreign owned firm obtains from a given level of R&D expenditures will exceed that of a domestically owned firm if the former can acquire at nominal cost access to the technical expertise of foreign affiliates. On the other hand it has been alleged that the R&D operations of foreign owned firms are principally engaged in product testing and in cataloguing the technical developments which occur elsewhere. The type of research which would produce patentable inventions is left

to the parent. In this case the inventive output yielded by a given level of R&D expenditures will be smaller for a foreign owned firm than for a domestically owned firm.

Incorporation of the modifications suggested above into equation (1) yields

$$P_{it} = k_0 + k_1 R_{it}^* + k_2 (R_{it}^*)^2 + k_3 S_{it}^* + k_4 (S_{it}^*) (R_{it}^*) + k_5 F_i + u_{it} \quad (2)$$

where  $R_{it}^* = \sum_{\text{all } k} w_k R_{it-j-k}$

$S_{it}^* = \sum_{\text{all } \ell} a_\ell S_{it-j-\ell}$

$F_i$  = one if the  $i^{\text{th}}$  firm is foreign owned, zero otherwise

$S_{it}$  = sales of the  $i^{\text{th}}$  firm during year  $t$ .

Equation (2) is estimated for each of the electrical, chemical and machinery industries (major groups) using a sample of 81 firms observed over the years 1967-71. The firms were assigned by Statistics Canada to the machinery industry (SIC codes 311-318), the electrical industry (SIC codes 331-339) or the chemical industry (SIC codes 372-379).

As was indicated earlier in this section, the practice of estimating the model for each major group allows for interindustry differences in both the average and marginal propensity to patent. The intercept term,  $k_0$ , is also

allowed to vary both from year to year and across three digit SIC industries. Since all other coefficients are constrained to be the same from year to year and for each three digit industry within a major group, this is equivalent to allowing for variation in the average but not in the marginal propensity to patent over time and over three digit industries within each major group. Any remaining differences in the propensity to patent are assumed to be random.

On occasion, the term  $S_{it}^*$  in equation (2) is either replaced by or used in conjunction with  $(S_{it}^*)^2$  in order to allow for a non-linear relationship between inventive output and firm size.

The lag distributions upon which  $R_{it}^*$  and  $S_{it}^*$  are based were chosen so as to minimize the standard error of estimate of the equation in which they appeared. The lag distributions chosen are:

$$R_{it}^* = .6R_{it-3} + .4R_{it-4}$$

$$S_{it}^* = .33S_{it-3} + .33S_{it-4} + .33S_{it-5}$$

Estimates of equation (2) are reported in Table VII. Estimates of the effect of firm size on the average product of R&D appear in Table VIII.

Table VII reveals that, other things being equal, an increase in R&D expenditures results in a subsequent increase in patenting activity in each of the three major

groups investigated. In each case the effect of a given increase in R&D spending on subsequent patenting activity depends on the size of the firm but not on the level of R&D spending itself. To be more specific, the marginal product of R&D is positive and an increasing function of firm size in the case of the chemical industry. It is initially positive and a decreasing function of firm size in the case of the electrical and machinery industries. In the former, the marginal product of R&D is zero for firms with annual sales in excess of \$400 million 1969 dollars. This does not imply that these firms have no inventive output. It implies that additions to the R&D budgets of firms in this industry and size class would not, other things being equal, result in additional patents.

The determinants of the level of patenting activity for any given level of R&D spending, that is, the average product of R&D, can be inferred from Tables VII and VIII. In one case, that of the electrical industry, foreign owned firms obtain fewer patents for any given level of R&D spending than do domestically owned firms. In the other two industries the average product of R&D is not affected by ownership.

In no case is there an unrestricted positive relationship between firm size and the average product of R&D. In the machinery industry the positive relationship between firm size and the number of patents which result from a given R&D outlay holds for R&D outlays of less than \$1.67

million. For larger R&D budgets the relationship is negative. In the chemical industry, an increase in firm size increases the average product of R&D for any R&D budget in excess of 1.2 million dollars. In the electrical industry, the average product of R&D increases with firm size for all firms with annual sales in excess of \$44 million (1969). It was reported above that the marginal product of R&D does not depend on the level of R&D spending. If patenting activities were a homogeneous function of R&D expenditures this would also imply constant returns to scale in the R&D operation itself. Given non-zero intercept terms (not reported) and annual sales in excess of zero, however, the simple patents-R&D relationship will have a positive intercept. In this case the average product of R&D approaches the marginal product asymptotically from above. More intuitively, the existence of a positive intercept implies that a firm will obtain some patents without making any R&D expenditures. When R&D expenditures are made, additional patents are obtained but the average number of patents per dollar R&D spending must fall.

The general conclusion is that an increase in firm size will result in an increase in the number of patents resulting from a given R&D outlay:

- (a) If it occurs among the larger firms in the electrical industry.

- (b) If it occurs among firms with relatively large R&D budgets in the chemical industry.
- (c) If it occurs among firms with relatively small R&D budgets in the machinery industry.

These conclusions are both too general and too specific. Given the quality of the data and the number of serious estimation problems encountered it is, perhaps, wise to be less specific, concluding that there is no compelling evidence of a general tendency for innovative activity to rise more than proportionately with firm size and there is no evidence whatever of increasing returns to scale in the R&D function itself. These conclusions are too general to serve other than as a warning that a merger defence based on an alleged general size-progressiveness relationship has little to commend itself.

TABLE VII  
ESTIMATES OF EQUATION (2)

Industry	Independent Variables				$\bar{R}^2$	N	F
	$R^*$	$S^*$	$(S^*)^2$	$(R^*)(S^*)$			
Electrical	.19( $10^{-2}$ ) (6.27)	-.21( $10^{-4}$ ) (2.17)	.24( $10^{-9}$ ) (8.68)	-.49( $10^{-8}$ ) (6.33)	.90	149	219.8
Chemical	.89( $10^{-3}$ ) (2.86)	-.18( $10^{-4}$ ) (2.85)	--	.15( $10^{-7}$ ) (5.18)	.77	123	82.6
Machinery	.56( $10^{-2}$ ) (3.62)	.77( $10^{-4}$ ) (3.36)	--	-.47( $10^{-7}$ ) (3.56)	.37	72	9.3

TABLE VIII  
THE EFFECT OF FIRM SIZE ON THE  
AVERAGE PRODUCT OF R & D

1. ELECTRICAL

$$\frac{\partial}{\partial S} \left( \frac{P}{R^*} \right) = .48(10^{-5}) \frac{S^*}{R^*} - .21 \frac{1}{R^*} - .49(10^{-4})$$

2. CHEMICAL

$$\frac{\partial}{\partial S} \left( \frac{P}{R^*} \right) = -\frac{.18}{R^*} + .15 (10^{-3})$$

3. MACHINERY

$$\frac{\partial}{\partial S} \left( \frac{P}{R^*} \right) = \frac{.77(10^{-4})}{R^*} - .47(10^{-7})$$

Source: Table VII

#### Notes: Chapter 4

1. Wood (1971) attempts to find a relationship between diversification and measures of both technical progressiveness and technical activity. He finds that the industries which were most frequently diversified into were also the most technologically oriented. This should not be taken to imply any causal relationship between diversification and progressiveness. It is quite consistent with the argument in the text that the internal transfer of technology via a diversifying merger may be the low cost method of disseminating new knowledge. Diversification is thus a function of technological activity. Any investigation of this relationship must take account of its probable simultaneity.
2. Results reported in this section have also been reported in McFetridge (1977).

OTHER SOURCES OF ECONOMIES:  
CONCLUSIONS AND DIRECTIONS FOR FUTURE RESEARCH

5.1 INTRODUCTION

In this chapter some other sources of economies of large firm size are listed and discussed briefly. The general conclusions reached in previous chapters are then summarized and, finally, some recommendations for future research are provided. Section 5.2 contains a short discussion of economies of scale in management per se and their relevance. In Section 5.3 the economies of multi-plant operation are listed and their importance assessed. Section 5.4 provides a perspective on the economies of marketing, finance and research examined in previous chapters. Some suggestions for future research appear in Section 5.5.

## 5.2 ECONOMIES OF SCALE IN MANAGEMENT FUNCTIONS

There may be economies of scale in other firm level functions such as the provision of legal, personnel or management systems services or in the monitoring function itself. This would imply that the resources required to provide legal, personnel or management systems services or to monitor the activities of the firm will rise less than proportionally with firm size. One route by which these economies could be effected is to participate in a larger number of geographic or product markets.

Economies of scale in the provision of these general management services will confer a particular advantage on the large or multi-market firm if (a) these economies are due to the existence of physical indivisibilities in the production of these services or (b) these economies have other sources such as specialization or increased dimension and transaction costs are such that it is more efficient to provide them internally than to purchase them on the market.

The existence and nature of scale economies in general managerial functions has been the subject of an intensive investigation by organization theorists. This study can not purport to do other than make a few general comments. Although it is by no means unanimous, the consensus of the literature appears to be that expansions into different markets, either geographic or product, will not result in any economies of monitoring or control, (Brown 1970, Whisler

1966). That is, in these cases one can not expect a less than proportional expansion of managerial personnel. Second, economies in the internal provision of such firm level services as are provided by personnel departments, legal departments and management systems departments are apparently limited, (Kitching 1967) and limited to such an extent that many conglomerates make no attempt to centralize them, (Berg 1969). One possible reason for this is the existence of a market for these services which is well developed, hence a relatively cheap one in which to participate.

If there are gains to be made from applying a given set of managerial services over a larger number of markets one might expect to observe a greater amount of multi-plant activity in the industries in which such services are relatively important. As a crude test of this proposition, the simple correlation between the ratio of administrative employees to production employees and the number of establishments per enterprise was calculated from data on 172 three and four digit SIC industries found in Statistics Canada (1976, Cat. No. 31-401). The average number of establishments operated by the largest four, eight and by all enterprises in each industry were employed in the calculation. If the above proposition is correct there should be a positive correlation between the relative importance of non-production employees and the number of establishments per enterprise. The correlation coefficients obtained vary from .24 to .31 and all are significant at the one per cent level. Multi-plant activity

does appear to increase as the importance of firm level inputs increases. It would also be of interest to know whether the same relationship exists between the importance of firm level inputs and the number of product markets in which a firm participates. Extensions of this obviously naive specification are also desirable. This task is left for others.

### 5.3 ECONOMIES OF MULTI-PLANT OPERATIONS

The extent and nature of the economies of multi-plant operation, that is, of participating in more than one geographic market, have been investigated in detail by Scherer, Beckenstein, Kaufer and Murphy (1975) and Beckenstein (1975) and (1976). In this section the arguments of these authors are summarized and discussed and some additional evidence is considered.

The principal advantages which are alleged to accrue to the multi-plant as opposed to single plant firm are (a) the economies of multi-plant investment staging, (b) the economies of massed reserves and (c) the economies of unbalanced plant specialization.

It will generally be the case that increases in demand will not be large enough to allow the firm to respond with optimally scaled additions to capacity. This will be the more likely the smaller the size of the market (the fewer the optimally scaled plants it can accommodate) and the

smaller the average market share of the firms involved.

In cases such as this capacity expansion will take one of the following forms: (a) add optimally scaled capacity and carry excess capacity; (b) add optimally scaled capacity and cut price; (c) add suboptimally scaled capacity equivalent to the increase in demand experienced; (d) refrain from expansion until increases in demand are sufficient to warrant an optimally scaled addition to capacity.

Each of these alternatives entails a different cost. The first entails the cost of carrying excess capacity, that is, the opportunity cost of the resources tied up in unused facilities. The second involves a reduction in profit due to moving from what was presumably a profit maximizing industry price. Provided elasticity of demand exceeds zero, the second approach will make some contribution to solving the capacity expansion problem but does so at the expense of selling each unit of output at a less than profit maximizing price. The third alternative involves the cost of producing in what, from a longer term point of view, is a less than optimally scaled facility. The fourth alternative can, but need not necessarily involve a reduction in market share which is not subsequently recoverable.

Scherer et al argue that the multi-plant firm has a fifth option, that of making optimally scaled additions to capacity in successive regional markets and supply the markets with deficient capacity from those with surplus capacity.

The multi-plant operator faces a strategic advantage in solving this dynamic capacity expansion problem. The multi-plant firm may choose to ship its product from distant plants temporarily in order to meet capacity deficits in other regions. As long as transport costs are cheaper than the costs of carrying excess capacity or relinquishing sales it would pay to do so, (Beckenstein (1976) p.12).

The same strategy is open to single plant firms. Producers could enter a contractual relationship specifying the order and size of capacity increments and the obligations of firms with surplus capacity to supply those with insufficient capacity. Beckenstein (1976, p.13) notes that exchanges of this nature are common in the U.S. petroleum industry. As the product becomes either more complex or more differentiated these agreements will become more costly. The advantage of the multi-plant firm over single plant operators will therefore be greater the more complex and differentiated the product. Where products have these characteristics, the rationalization of capacity expansion and hence of capacity itself will be more likely the greater is the proportion of output accounted for by multi-plant firms.

Dickson (1976) has examined the determinants of inter-industry differences in the proportion of output coming from optimally scaled plants, that is, in the degree of capacity rationalization. As expected, he found the level of rationalization increased with market size and with average market share (seller concentration). He also found, first, that the level of rationalization decreased as the level of effective tariff protection increased and, second, that the

level of rationalization increased with the per unit cost disadvantage of small scale production. In the light of the discussion above one might expect that, for any given market size and level of enterprise concentration, the proportion of output coming from optimally scaled plants would increase with the extent of multi-plant activity. It does not. There are several possible reasons for this. First, the expectation was that this effect would appear only among industries in which rationalization by contract is relatively costly. Dickson does not isolate this component of his sample. Second, the greater the transportation costs, the smaller are the potential gains from rationalization either by contract or within the firm. The marginal influence of multi-plant activity on rationalization therefore increases as transportation costs decrease. This relationship has not been tested. Finally, there is a threshold of transportation costs above which inter-market shipments and hence any rationalization of capacity expansion is precluded. It may be that most of Canadian industry is beyond this threshold.

The attachment of costs, in terms of lost market share, of refraining from expansion until demand warrants an optimally scaled addition to capacity implies that economic profits are being earned and these profits are somehow contingent on the firm's market share. A firm earning normal profits on existing capacity and expecting the same on additional capacity, provided it was optimally scaled, would be indifferent to its market share. Market share becomes impor-

tant only in the presence of some sort of cartel. Efficient expansion of capacity becomes a problem only in the context of a market which is already inefficient. It is, therefore, very much a problem in the economics of the second best and conclusions reached by any investigators are subject to the usual second best caveats.

It is also alleged that the multi-plant firm has an advantage in responding to random production stoppages or shifts in demand.

Firms must hedge against periodic demand peaks and unforeseen production failures in order to maximize profits. They can do so by holding inventories and/or building excess capacity. But the multi-plant firm has another strategic option. It can ship from other plants to help meet the crisis at the region where demand is peaking or production is temporarily curtailed. Put another way, as long as there is some independence between the stochastic demand or production phenomena in varying regions, and as long as transport costs do not outweigh the savings, the multi-plant firm will be able to maintain lower inventory and reserve capacity levels per unit sold. (Beckenstein, 1976, p.14).

The argument is incomplete as it stands. Given randomness of demand and output fluctuations some measures can be taken to ensure continuity of supply. One possibility is the shipment of output from other plants owned by the same firm. A second possibility is for single plant enterprises to enter into contractual arrangements which commit each enterprise to supply others facing random excesses of demand over output. A third possibility is for the buyers of the product

to arrange to purchase the latter from other single plant enterprises. This arrangement could take either the form of a contractual arrangement with these producers to provide "stand-by" supplies or the form of spot purchases.

The important factor is the randomness of production and demand fluctuations. This implies that there is some method of ensuring continuity of supply. The multi-plant firm is not necessarily the lowest cost method of doing this. If it is not, the economies of massed reserves can not be adduced as a defence for the multi-plant firm.

A final advantage attributed to the multi-plant firm is its ability to centralize production of some products, those with low volume, high product specific scale economies and relatively low transportation costs, and decentralize those characterized by high volumes, lower product specific scale economies and higher transportation costs. This is labelled by Beckenstein (1975, p.646) as unbalanced product specialization. Such specialization is also in the interest of single plant firms and may well be achieved by single plant operators pursuing their own self-interest. Specialization arrangements may also be made by contract. Again the gains from multi-plant product specialization appear to be greatest when the product is differentiated (each firm's product is recognizable and each firm feels obliged to produce a range (full line) of products). The multi-plant firm is thus efficient only in the context of an already inefficient situation. One is again conducting an exercise in the economics of the second best.

#### 5.4 ECONOMICS IN MARKETING, FINANCE AND RESEARCH AND DEVELOPMENT

The results obtained in Chapter 2 indicate, first, that there are advantages in purchasing advertising on a large scale. It is not known whether these advantages are real or whether only large firms can purchase advertising on a large scale. Second, there is no evidence that large firms export proportionately more than small firms. This implies that scale economies in international marketing are either insignificant or that these economies are such that small firms can avail themselves of them via market purchases of international marketing services. In either case the cliché that "you must be big to export" is neither supported by the evidence nor a useful basis for policy.

Chapter 3 reported the results of attempts to measure the economies of scale in financial activities. The first question examined was whether large firms incur proportionately lower costs when participating in the capital market. It was necessary to rely on indirect evidence here and a number of the indirect tests proposed in the literature proved to be ill-conceived. Some evidence indicated large firms were more profitable than the small, other evidence indicated that this was not so. There was some inconclusive evidence that small firms are obliged to rely more heavily on internal sources of funds than are large firms. This could have been due to diseconomies of small scale participation in the capital market.

The efficiency and pervasiveness of the internal capital market was the second issue examined. It was found that the internal capital market allocates resources efficiently. There is some indication that the internal capital market is limited in its horizons. That is, it allocates resources to a limited range of activities known to the participants in the firm. It is not a substitute for a general capital market. Whether the resources cost of allocating capital within the firm generally exceeds the cost of doing the same thing in the market is an important unresolved question.

The role of the large firm as a vehicle for risk reduction was the third issue examined. It was found that the large firm has not achieved the type of risk reduction for its owners which could have been effected by an individual assembling his own portfolio. Moreover, if evidence that the returns to large firms were less subject than those of small firms to general economic fluctuations had been unearthed, there would still be no evidence that the large firm could achieve this risk reduction more efficiently than could an individual assembling his own portfolio.

Chapter 4 examines the assertion that large firms are the engines of progress. It was found that in the manufacturing industries examined the largest firms obtained most of the Canadian inspired patents, while these firms were large they were generally not widely diversified and were certainly not conglomerates in the usual sense of the word. It was

also found that, subject to some qualifications, large firms obtained more patents from a given commitment of resources to R&D. This does not necessarily imply that R&D establishments must be embedded in a large firm to be productive. An R&D establishment in a small firm could do a large proportion of contract work or sell results to others who would then obtain the patents. Although patents are generated under the approach taken here, the originating establishment will simply not get credit for them. This serves to introduce the crucial unresolved question in this area. What disadvantage is there in having R&D carried out by organizations other than those which may ultimately use it? If there is little, there seems no reason why smaller firms can not avail themselves of the research they require via market as opposed to intra-firm exchanges. There would also seem little scope for a merger defence based on the notion of R&D synergisms.

## 5.5 DIRECTIONS FOR FUTURE RESEARCH

The amount of information of which the authors were aware was not sufficient to resolve any of the issues confronted. This is especially true of the costs of participating in the capital market.

Aside from the generation of data on the amount actually paid for advertising or the costs of participating in the capital market or on the characteristics of new entrants, some new theoretical approaches remain to be taken. All economic activity involves exchange. Some exchanges are defined as being within the firm and others within the market. The transfer of an exchange from the market to the firm category results in a larger firm and this is labelled as cause for social concern. There must be a clear division between those transfers which are trivial and those which may truly effect a change in society. It may also be the case that public policy is forcing more exchanges to be conducted within the firm. It may be, for example, that the cost (largely in terms of time) of resolving contractual disputes within the judicial system may force many potentially contractual exchanges to be carried out within the firm and so contribute to the growth of firms.

If the influence of the state on the type of exchange conducted is one avenue of future research the other is the resource cost of exchange itself. Does the internal capital market operate at a lower cost than the external

market? Within what range of firm sizes? Can R&D results be transmitted most efficiently from producer to user if both are in the same firm? For what class of firms and range of results is this true? Can risk be reduced more effectively by the individual assembling his own portfolio or by the holding company or conglomerate acting on his behalf? Can the small firm obtain the services of international marketing specialists on the market?

It was once fashionable to speak of the rationale for mergers in terms of synergisms. A synergism is nothing other than the possibility of mutually beneficial exchange. Two different values are placed on the same asset. To say that there will be opportunities for exchange is trivial. The important question is whether that exchange must be internalized and whether the actions of the state can affect the incentives to internalize it.

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